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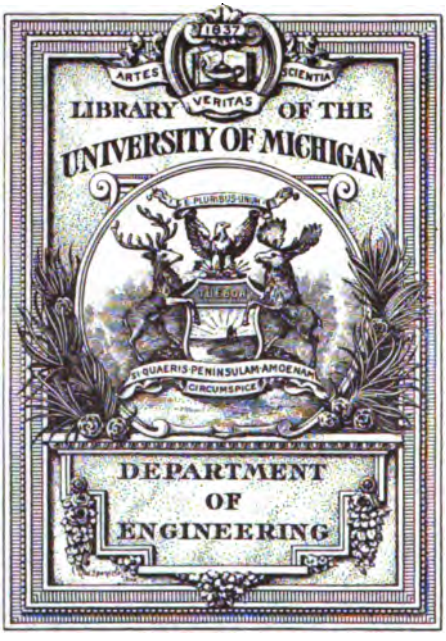
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PROCEEDINGS

OF THE

ELEVENTH ANNUAL CONVENTION

OF THE

Association of Railway Superintendents of Bridges and Buildings,

HELD IN

ATLANTA, GEORGIA,

OCTOBER 15, 16, AND 17, 1901.

CONCORD, N. H.:
THE RUMFORD PRESS.
1901.

COST OF MIXING, LOWEST.
QUALITY OF MIXING, HIGHEST.

RANSOME'S CELEBRATED CONCRETE MIXERS

CHICAGO, MILWAUKEE AND ST. PAUL R'Y CO.,
BRIDGE AND BUILDING DEPARTMENT.
CHICAGO, Nov. 5th, 1898.

MR. E. L. RANSOME.

Dear Sir:—We have used our 2,000 cu. ft. capacity portable Ransome Concrete Mixer, to mix the concrete for the concrete abutments built for the subways of our track elevation in Chicago this year.

In my opinion the output of this mixer is as nearly perfect a mixture as can be made. I consider it much superior to that mixed by hand although made at less cost.

Yours truly,
W. A. ROGERS,
Asst. Engineer Bridges and B'l'dgs Dept.

RANSOME & SMITH CO.,

DESIGNERS AND MFRS. OF

Concrete Machinery,

Bowling Green Building, 11 Broadway, NEW YORK CITY.

SEND FOR CIRCULAR.

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B. F. PICKERING . . . . . FIRST VICE-PRESIDENT.
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A. SHANE . . . . . SECOND VICE-PRESIDENT.
Toledo, St. Louis & Kansas City Railroad, Frankfort, Ind.

A. ZIMMERMAN . . . . . THIRD VICE-PRESIDENT.
Colorado & Southern Railway, Denver, Col.

C. C. MALLARD . . . . . FOURTH VICE-PRESIDENT.
Southern Pacific Co., Algiers, La.

S. F. PATTERSON . . . . . SECRETARY.
Boston & Maine Railroad, Concord, N. H.

N. W. THOMPSON . . . . . TREASURER.
Pittsburg, Fort Wayne & Chicago Railway, Fort Wayne, Ind.

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Chicago & North Western Railway.

W. E. SMITH . . . . . Chicago, Ill.
Chicago, Milwaukee & St. Paul Railway.

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Chicago & Eastern Illinois Railroad.

WALTER A. ROGERS . . . 1203 Manhattan Building, Chicago, Ill.

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COMMITTEES FOR 1901-1902.

COMMITTEE ON SUBJECTS FOR REPORT AND DISCUSSION.

1. Auxiliary coaling stations; best designs, capacity and method of handling coal.

W. A. McGonagle, D. & I. R. R. Co., Two Harbors, Minn., Chairman.
G. W. Smith, C., M. & St. P. Ry., Chicago, Ill.
E. Fisher, Mo. Pac. Ry., Pacific, Mo.
J. P. Snow, B. & M. R. R., Boston, Mass.
B. F. Bond, J. & St. L. Ry., Jacksonville, Ill.
R. B. Tweedy, Wis. Cent. Ry., Milwaukee, Wis.

2. Roof coverings, first cost, life, efficiency and maintenance expenses for various classes of railroad buildings.

E. Fisher, Missouri Pacific Ry., Pacific, Mo., Chairman.
R. H. Reed, L. S. & M. S., Cleveland, Ohio.
J. S. Berry, S. T. S. W. Ry., Tyler, Texas.
J. P. Snow, B. & M. R. R., Boston, Mass.

3. Mail cranes, first cost, efficiency and maintenance of various styles in use.

A. S. Markley, Chicago & Eastern Illinois R. R. Co., Danville, Ill., Chairman.
F. Price, Plant System, Way Cross, Ga.
James Brady, Chicago, Rock Island & Pacific Ry., Davenport, Ia.
G. W. Smith, C., M. & St. P. Ry., Chicago, Ill.
D. W. Lum, Southern Ry., Washington, D. C.

4. Best method of protecting low overhead structures over tracks from gases and blast of locomotives.

G. W. Andrews, B. & O. R. R., Baltimore, Md., Chairman.
J. S. Lemond, Southern Ry., Atlanta, Ga.
C. M. Large, Erie & Pittsburg Ry., Jamestown, Pa.
A. H. King, Union Pacific Ry., Cheyenne, Wyo.
James T. Carpenter, L. E. & St. L. R. R., Princeton, Ind.
E. H. R. Green, Texas Midland R. R., Terrell, Texas.
A. E. Killam, Intercolonial Ry., Moncton, N. B.

5. What has been the experience in the use of concrete under bridge bed plates and turn-tables in place of pedestal stones, and what is the best form and material for bed plates under various styles of iron bridges?

W. A. Rogers, Chicago, Ill., Chairman, 1203 Manhattan Building.
Frank W. Tanner, Missouri Pacific Ry., Atchison, Kansas.
George J. Bishop, C., R. I. & P. Ry., Topeka, Kansas.
J. H. Markley, Toledo, Peoria & Western Ry. Co., Peoria, Ill.
A. McNab, Pere Marquette R. R., Holland, Mich.
George E. Hanks, Pere Marquette R. R., East Saginaw, Mich.

6. Best design and recent practice in building railroad track pile-driver.

T. M. Strain, Wabash R. R., Springfield, Ill., Chairman.
A. W. Merrick, C. & N. W. Ry., Huron, S. D.
Chas. C. Mallard, Southern Pacific Ry., Algiers, La.
A. B. Manning, M., K. & T. Ry., Parsons, Kansas.
W. M. Noon, Duluth, South Shore & Atlantic Ry., Marquette, Mich.
W. T. Powell, Colorado & Southern, Denver, Col.

7. Best material and designs for roundhouse pits, including drainage and rail fastenings.

Arthur Montzheimer, C. & N. W. Ry., Milwaukee, Wis., Chairman.
E. M. Gilchrist, H. & St. J. R. R., Brookfield, Mo.
J. W. Taylor, Terminal R. R. Association, St. Louis, Mo.
James Stannard, Wabash R. R., Moberly, Mo.
Onward Bates, Chicago, Ill., 1203 Manhattan Building.

8. Best materials for wearing surface of roadway of highway bridge floors.

W. O. Eggleston, C. & E. R. R., Huntington, Ind., Chairman.
B. F. Pickering, B. & M. R. R., Sanbornville, N. H.
J. B. Sheldon, N. Y., N. H. & H. R. R., Woonsocket, R. I.
C. P. Austin, B. & M. R. R., Medford, Mass.
Joseph M. Staten, C. & O. Ry., Richmond, Va.
O. J. Travis, Illinois Central Ry., Chicago, Ill.

COMMITTEE ON SUBJECTS.

Walter G. Berg, Lehigh Valley Ry., New York City, Chairman.
C. C. Mallard, Southern Pacific Ry., Algiers, La.
J. H. Cummin, Long Island R. R., Long Island City, N. Y.
W. E. Smith, C., M. & St. P. Ry., Greenbay, Wis.
J. D. Isaacs, Southern Pacific Ry., San Francisco, Cal.
C. W. Gooch, 1325 West 9th St., Des Moines, Iowa.
L. F. Goodale, H. & St. J. R. R., St. Joseph, Mo.
W. A. McGonagle, D. & I. R. R. R. Co., Two Harbors, Minn.

COMMITTEE ON APPLICATIONS FOR MEMBERSHIP.

A. W. Merrick, C. & N. W. Ry., Huron, S. D., Chairman.
H. D. Cleaveland, P., B. & L. E. R. R., Greenville, Pa.
Chas. Carr, M. C. R. R., Jackson, Mich.

COMMITTEE ON RELIEF.

James Stannard, Wabash R. R., Moberly, Mo., Chairman.
C. W. Vandergrift, C. & O. Ry., Alderson, W. Va.
George J. Bishop, C., R. I. & P. Ry., Topeka, Kansas.
J. Y. Hill, Memphis Division Southern Ry., Tuscumbia, Ala.

COMMITTEE ON ENTERTAINMENT.

W. A. McGonagle, D. & I. R. R. Co., Two Harbors, Minn., Chairman.
C. A. Lichty, C. & N. W. Ry., Lake City, Ia.

PROCEEDINGS OF THE ELEVENTH ANNUAL CONVENTION

OF THE

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

HELD IN ATLANTA, GEORGIA, OCTOBER 15, 16, AND 17, 1901.

MORNING SESSION.

TUESDAY, October 15, 1901.

The Convention was called to order by the president, Mr. Walter A. Rogers, at 10:09 o'clock a. m., Tuesday, October 15, 1901, in the spacious ball-room of the Kimball House, Atlanta, Georgia.

President.—I will ask our worthy member, Mr. J. H. Cummin, to offer prayer.

Prayer was offered by Mr. Cummin.

President.—Ladies and gentlemen, I take great pleasure in introducing to you Hon. Allyn D. Candler, the governor of Georgia, who is about to address us.

Governor Candler.—Ladies and gentlemen, I have stolen a moment from the inexorable demands of official duty to welcome you to the Empire state of the South. One division, at least, of those men who have made this the greatest republic of the earth, the most progressive and enterprising nation of the earth. You do well, Mr. President, to come to Georgia; you do well because we are glad to have you in Georgia. It is appropriate that you meet here, because Georgia was a pioneer state in the building of railroads. A long time ago, as the ladies are here, I will not say how long, but when a boy, and when I went outside of the state of Georgia to Ohio, Michigan, and other places, I heard the people speak of Georgia as "that railroad state." Georgia was foremost known in the building of railroads, and she maintained her lead

until the beginning of that unfortunate state of war which devastated the entire South, when railroad building ceased for a certain time; necessarily ceased because the material wealth of this old commonwealth had been reduced from two thousand millions to one hundred and eighty-four millions; but enterprise was reinaugurated in Georgia, especially railroad enterprise, and she rallied. She was an inviting field to capitalists, and railroad building was revived, and to-day she has more than five thousand miles of railroads within her borders. She has fostered these roads; it has been the policy of the state from the beginning, from the day on which the old South Carolina railroad, from Charleston to Augusta, Georgia, one of the first roads completed on the American continent, from that day to this, Georgia has fostered her railroads. There has, as a matter of course, in this state, as also in other states, been some friction at times between the roads and their patrons, but it has never reached the degree of acrimony which it has reached in other states. Nearly a quarter of a century ago the general assembly of this state led off in the inevitable railroad commission to adjust the differences between the railroad corporations of the state and the patrons of those corporations. This commission was intended to adjust fairly and equitably all questions that might arise, and to adjust those questions in such a way as to avoid this friction which has existed in other portions of the country. The result is, that our roads have done well and our people have done well. We owe our railroads, not only to the enterprise of our own people, but we owe them largely to the enterprise and to the skill of that class of men which you represent, the builders of the railroads. (Applause.)

Now, as I understand the object of this meeting or the business of this organization, it is, you are the men who build the bridges and trestles and that class of railroad work. Now, Brother President, I have had a little experience in that line. I have built some trestles myself, but I fell from grace, and got to be governor of Georgia (laughter), the only man, I believe, in the history of this commonwealth outside of two doctors and about two score lawyers and two or three farmers, who was ever governor of the commonwealth. I am certainly the only railroad man that was ever governor, and I am not much of a railroad man; still I do not belong to either of the classes that I have named, therefore,

I am in sympathy with this organization, and "fellow feeling makes us wondrous kind," and I have that feeling with you, gentlemen. I repeat that Georgia is an appropriate place to have this meeting, and I am here just on the eve of the convening of the general assembly of this state, which will, in the language of President Cleveland, "be on my hands for the next fifty days." Now, just on the eve of this assembly, I am here to bid you welcome to the Empire state of Georgia. You are here, you are in the hands of friends, and I open the gates of the state wide to you. It is yours while here; take what you see and if you want anything you do n't see, ask for it. (Applause.)

President.—In behalf of the Association, I ask Mr. Cummin to reply.

Mr. Cummin.—Governor Candler, I do n't know why the president of this Association should call on me to respond to the eloquent remarks you have just uttered, unless it is that as you are the governor of the Empire state of the South, I am a representative from the Empire state of the North, coming from the little town of which I suppose every citizen of Georgia has heard, where we have a little hall on Fourteenth street known as Tammany Hall. I appreciate, and I think every member of our Association feels the same way, the kind, cordial, and friendly greeting that you have extended to us. We all know that there is no section of this land where the real generous hospitality is extended to strangers as much as it is in the Southland. I must confess I feel a great deal better than I did a few moments ago. I thought when I was gazing upon the governor of the state of Georgia, I was looking upon a man that I ought to look up to with a great deal of awe and veneration, but I feel better now to find out that a superintendent of bridges and buildings who has not fallen from grace is far superior to the chief executive of the state. I simply acknowledge the truth of your words. I have never been fortunate enough to fall from grace in that manner. However, I do not say that I would not like to have an opportunity. I am surprised to find that in the state of Georgia you should ever have any friction between the public and the railroad authorities. I had supposed that that was confined exclusively to our section of the country. In the state where I come from, I do not think there is a commuter on one of the railroads, that travels ten miles a day,

but what is fully convinced in his own mind, that he could give the executive officers of the railroad points without number in regard to how the road should be properly run. We have met here, as we have at other places for the past eleven years, to try and educate ourselves. Our late president, in the last speech that he ever made, in Buffalo, the day before he was assassinated, said in effect, that the interchange of ideas was the best educational factor in existence. That is what we are here for. The interchange of ideas on the different subjects connected with our work, and to try in our feeble manner to draw out from the members of our Association the best points that we can. I appreciate, as I know every one of our members do, your kindness in tearing yourself away from your official duties, to come here for a short time and give us a welcome to your city and state, and I thank you, sir, in behalf of our Association, for the kind words of greeting that you have extended to us. (Applause.)

President.—The next order of business is the calling of the roll. The secretary then called the roll, and the following members responded:

ROLL CALL.

AUSTIN, CYRUS P., B. & M. R. R., Medford, Mass.
BERG, WALTER G., L. V. R. R., New York, N. Y.
CARPENTER, JAMES T., L. E. & St. L. R. R., Princeton, Ind.
CARR, CHARLES, M. C. R. R., Jackson, Mich.
CLARK, WM. M., P. & W. Ry., Etna, Pa.
CLEAVELAND, H. D., P., B. & L. E. R. R., Greenville, Pa.
CUMMIN, J. H., L. I. R. R., Long Island City, N. Y.
EGGLESTON, WM. O., C. & E. R. R., Huntington, Ind.
FLETCHER, H. W., 2366 California Ave., Allegheny, Pa.
FOREMAN, JOHN, P. & R. R. R., Pottstown, Pa.
FORT, WM. A., Southern Ry., Columbia, S. C.
HANKS, GEO. E., F. & P. M. Ry., East Saginaw, Mich.
HENSON, H. M., C. & N. R. R., Gallatin, Tenn.
KILLAM, A. E., Intercolonial Ry., Moncton, N. B.
LARGE, C. M., E. & P. R. R., Jamestown, Pa.
LICHTY, C. A., N. West Lines, Clinton, Iowa.
MARKLEY, A. S., C. & E. I. R. R., Danville, Ill.
MALLARD, C. C., So. Pac. Ry., Algiers, La.

McGehee, G. W., M. & O. R. R., Okolona, Miss.
McIntyre, James, E. R. R., Cleveland, Ohio.
McNab, A., P. M. R. R., Holland, Mich.
Patterson, S. F., B. & M. R. R., Concord, N. H.
Pickering, B. F., B. & M. R. R., Sanbornville, N. H.
Rettinghouse, H., C. & N. W. Ry., Kaukauna, Wis.
Rogers, W. A., 1203 Manhattan Building, Chicago, Ill.
Riney, M., C. & N. W. R. R., Baraboo, Wis.
Schall, F. E., L. V. R. R., South Bethlehem, Pa.
Sheldon, J. B., N. Y., N. H. & H. R. R., Providence, R. I.
Stannard, James, Wabash R. R., Moberly, Mo.
Staten, Joseph M., C. & O. Ry., Richmond, Va.
Thompson, N. W., P., F. W. & C. Ry., Fort Wayne, Ind.
Vandergrift, C. W., C. & O. Ry., Alderson, W. Va.
Welker, Geo. W., So. Ry., Alexandria, Va.
Zimmerman, A., Col. & Southern Ry., Denver, Col.

The following applicants for membership, subsequently elected, were also present:

Bell, W. E., Plant System, Thomasville, Ga.
Canty, John P., B. & M. R. R., Fitchburg, Mass.
Cooper, A. R., Plant System, Montgomery, Ala.
Darracott, T. J., Plant System, Lakeland, Fla.
Killebrew, O. D., Southern Ry., Columbia, S. C.
Lemond, J. S., Southern Ry., Atlanta, Ga.
Lovett, J. W., Southern Ry., Atlanta, Ga.
Nelson, O. T., Atlanta & W. Pt., Montgomery, Ala.
Newton, J. B., Plant System, Ridgeland, S. C.
Price, L. S., Plant System, Waycross, Ga.
Rosseau, J. H., So. Ry., Birmingham, Ala.
Tucker, M. F., Central of Ga., Americus, Ga.

President.—The reading of the minutes of the last meeting is the next order of business.

Mr. Cummin.—Mr. President, inasmuch as the proceedings have been published and have been in the hands of the members for a number of months, I move that this be dispensed with, and that the minutes be approved as printed.

Motion seconded and carried.

President.—I notice some of the ladies are beginning to look

weary, and as the routine business is coming up, I would suggest that a committee be appointed to distribute the guests' badges to them, after which they can retire, if they so desire. I will appoint Mr. Cummin and Mr. Markley a committee to distribute the badges, and while this is being done Mr. Mallard might care to say a few words to the members relative to the entertainment features that have been provided.

Mr. Cummin.—Mr. President, I think the best feature of entertainment, just now, would be to allow the members to shake hands with the governor.

Thereupon the president announced a recess to greet the governor.

President.—The meeting will please come to order. I will appoint Mr. Pickering assistant secretary of the Convention. Now we will hear from Mr. Mallard.

Mr. C. C. Mallard, chairman of the Entertainment Committee, then made announcements in regard to the different entertainment features which had been provided for the members and guests during the Convention, stating that, while he was appointed chairman of that committee, nearly all the credit was due Messrs. J. S. Lemond and J. W. Lovett.

President.—The next order of business is report of the Committee on Applications for membership. Inasmuch as none of the original membership committee are here, the president has taken it upon himself to appoint Mr. Lichty to represent that committee. We will now hear from Mr. Lichty.

Mr. Lichty read report of the Committee on Applications for Membership.

REPORT OF COMMITTEE ON APPLICATIONS.

The following applicants are recommended for membership in the Association:

O. T. NELSON, Atl. & W. Pt. & W. Ry. of Ala.
R. J. BRUCE, P., C., C. & St. L. Ry.
M. F. TUCKER, Central Ry. of Ga.
J. W. LOVETT, Southern Ry.
T. R. HIME, Central Ry. of Ga.
C. R. WELTON, Southern Ry.
W. R. WOODARD, Southern Ry.

D. W. LUM, Southern Ry.
O. D. KILLEBREW, Southern Ry.
J. H. ROSSEAU, Southern Ry.
I. W. EVANS, Southern Ry.
B. A. GUILL, Georgia R. R.
W. M. ROBINSON, Georgia R. R.
T. J. DARRACOTT, Plant System.
H. C. KEITH, M. C. & Ft. Dodge R. R.
GEO. F. POWERS, L. S. & E. Ry.
J. R. POOL, Choc., O. K. & Gulf R. R.
J. W. TAYLOR, Ter. R. R. Assn. of St. Louis.
W. E. ALEXANDER, B. & Aroostook R. R.
W. E. BELL, Plant System.
A. S. BLODGETT, K. C., F. S. & M. Ry.
JOHN P. CANTY, Boston & Maine.
H. H. EGGLESTON, C., C., C. & St. L. Ry.
J. C. HAIN, C., M. & St. P. Ry.
E. P. HAWKINS, M. & O. R. R.
F. F. LLOYD, So. Pac. Co.
C. F. LAWETH, C., M. & St. P. Ry.
L. F. PRICE, Plant System.
R. H. REID, L. S. & M. S. Ry.
H. M. SAUMENING, Ferro carrill National de Tehauntepec Ry.
D. A. SHOPE, Santa Fe & Pac. R. R.
L. D. SMITH, Gulf, Col. & Santa Fe Ry.
W. T. POWELL, Colorado & Southern.
J. B. NEWTON, Plant System.
A. R. COOPER, Plant System.
W. H. R. TERRY, C. & O. Ry.
A. C. CARR, L. & N. R. R.
J. S. LEMOND, Southern Ry.

C. A. LICHTY,
For Committee.

President.—Gentlemen, what shall we do with the report of the Committee on Membership?

Mr. Berg.—I move that the secretary cast one ballot for the thirty-eight names read.

Motion seconded and carried.

President.—The secretary is so instructed, and I declare the thirty-eight gentlemen elected members of the Association.

Mr. Berg.—Mr. President, I would suggest that the new members who have been elected and who are present step forward, and a recess be taken to greet them.

President.—We will take a recess for that purpose, and I would be glad to have them come forward, that we may shake hands with them and welcome them into our Association.

A recess was then taken to introduce the new members, after which the meeting was called to order, and the president delivered his annual address.

President.—Ladies and Gentlemen, members of the Association of Railway Superintendents of Bridges and Buildings: It is with great pleasure that I welcome you to the Eleventh Annual Convention of our Association in this beautiful city of Atlanta. You have come from far and near, from points widely separated on the great network of railroads stretching over the face of this continent. As I look into your faces I cannot refrain from asking, Why have we come so far, perhaps at a great sacrifice of time, at a season when every day is valuable; what is the end in view? The answer that immediately comes to mind is, We have met together that, as members of our Association, we may study together the problems that confront us in our business, that we may interchange ideas as to methods and tools, that we may become better acquainted personally, and, in a word, we have met together because we believe that the meeting will make us more proficient, better superintendents of bridges and buildings. We have found from past experience that the attendance at each Convention has better fitted us for our positions with our employers, the great transportation companies. We are anxious to make each Convention more successful than those that have gone before. It is well, therefore, that we should spend a few moments in considering the questions, What can we do for our Association? What can our Association do for us?

The Association of Railway Superintendents of Bridges and Buildings has passed the experimental stage. It has taken its place as one of the strongest and best of the railway technical societies. Its published proceedings are among the best of their class, and are highly prized by technical men. To be a member

of this Association is considered a privilege, and is evidence of a desire to be progressive. Our membership roll contains the names of many of the foremost railway bridge and building department men of the country. We should not, however, rest with our present membership. We should each appoint himself a membership committee of one to hunt out desirable men, present to them the objects of our Association, and get them to join with us. We want all of the live bridge and building department men of the country, men who want to improve, who are anxious to learn what their fellows are doing and ready to adopt new ideas and improved methods, men who are up to date and are ready and willing to help others to learn the best ways of doing work. We want men who will serve on committees and take their share of the burden. The ordinary superintendent of bridges and buildings is a very busy man, but time spent in work for the Association, and in attendance at the Convention, is time saved, because well spent.

We must keep up the interest of our Convention by varying the programs. There is always the danger of getting into a "rut." Papers on well-selected subjects, or descriptions of work accomplished, are very interesting and valuable. Descriptions of particular jobs, even though they may not be out of the ordinary, are instructive, in that they show individual methods. Our committee reports are a very important feature of our Convention, and the information collected by the members is invaluable. Many of them in their printed form are referred to constantly by those interested, others contain information that cannot be obtained from any other source.

The speaker has thought that it might seem best to the Association to occasionally appoint a committee to carry on a line of experiments to throw light on important features of our work. It might be of value for us to go into the question of specifications for different classes of work or materials that we use. This is merely a suggestion, and may have little value. The idea that the speaker wishes to convey is that we should guard against sameness in our programs and work. A lecture by an outsider on some subject of interest to us, especially if the lecturer be an expert in his line, might be a pleasant variation. Let us, however, confine ourselves, both in selecting subjects for committee

reports, papers, etc., carefully to that which belongs strictly to the bridge and building department. As members, as far as consistent with other duties, let us take our proper place on the committees, not only for the benefit of the Association, but for our own good. The speaker believes that, as a rule, the chairman and members of a committee are well repaid for their efforts in getting together the material and formulating a good report on any subject, by the knowledge they gain in the investigation.

Now as to our conventions. First, let us attend them, then let us take an active part in the discussions of those subjects on which we are posted. In the discussions let us state what we have to say concisely and to the point. The speaker believes that the custom of the Association in arranging for pleasure trips in connection with its annual Convention is an admirable one, and one to be continued in just the way that it has been handled in the past, making it an attractive feature but a secondary one. A little relaxation once a year is a good thing if properly sandwiched in with the sessions of the Convention. It keeps our minds fresh and active for the work in hand, and we return to our duties better for it.

The committee which has had charge of the arrangements for this Convention are especially to be commended for the efficient manner in which they have outlined and executed this feature.

We, as members, owe a large debt of gratitude to the older members of the Association who organized it on the same basis on which it stands, carefully outlining its policy, and kept it from falling into error. Those of us who joined later realize only in a measure the hard work, the time and strength, given by the little band of older members to make it the success that it now is. It may partially recompense them to look on the result of their efforts, and see how successfully they have built. It is the belief of the speaker that the good effects of this Association are felt far more widely than we can know. It has made many a man a better superintendent of bridges and buildings than he would have been without its influence. We are doing our work better and more economically because of that which we have learned at its conventions, or from its published proceedings. Let us continue the good work with renewed vigor. The Association was never in a better condition than it is to-day. You will realize this

better after listening to the reports of your various officers. We are pleased to be able to say that death has not claimed any of our members during the year now passed.

I want to thank the chairmen and members of the various committees for their work during the past year. I want to thank you for the honor you have bestowed upon me, for consideration shown me, and the kindnesses extended to me. I trust that you will bear with me in my position as presiding officer of this Convention. I shall always remember with pleasure the meetings of this Association that I have been able to attend. In closing I would leave with you this wish, "Long live the Association of Railway Superintendents of Bridges and Buildings. Long may it prosper." (Applause.)

President.—The next order of business is the annual report of the Executive Committee.

The annual report of the Executive Committee was then read by Secretary Patterson.

ANNUAL REPORT OF EXECUTIVE COMMITTEE.

ABSTRACT OF MINUTES OF MEETING OF EXECUTIVE COMMITTEE HELD AT THE SOUTHERN HOTEL, ST. LOUIS, MO., OCT. 18, 1900.

Meeting called to order at 12 o'clock noon, by T. M. Strain, chairman.

Present: T. M. Strain, S. F. Patterson, N. W. Thompson, W. G. Berg, J. H. Cummin, W. A. Rogers, James Stannard, F. W. Tanner, A. S. Markley, A. W. Merrick, and W. A. McGonagle.

On motion of Mr. Cummin, Mr. W. G. Berg was appointed a committee to act in connection with the secretary in editing the proceedings of the Convention. The secretary was instructed to have 1,000 copies of proceedings of tenth annual convention printed. Also selling price of Proceedings to be 75 cents a copy. President Rogers was instructed to appoint the local committee to arrange for our Atlanta convention and report at the spring meeting of the Executive Committee.

The president was requested to prepare a programme for the next Convention and present it at the spring meeting of the Executive Committee.

The matter of remuneration of the stenographer for our tenth

convention was referred to the president and secretary, with power to act.

By vote the spring meeting of the Executive Committee was to be held in Chicago, at the call of the chairman, and sufficient notice be given to the executive members.

Voted to adjourn, subject to the call of the chairman.

ABSTRACT OF MINUTES OF MEETING OF EXECUTIVE COMMITTEE, HELD AT THE LELAND HOTEL, CHICAGO, FEB. 18, 1901.

Meeting called to order at 10:10 a. m., by Mr. T. M. Strain, chrairman.

Mr. A. W. Merrick was appointed by the chairman to act as secretary *pro tem.*

Present: T. M. Strain, chairman, O. J. Travis, A. W. Merrick, W. A. Rogers, James Stannard, W. E. Smith, N. W. Thompson, Arthur Montzheimer, and A. S. Markley.

Minutes of last meeting read and approved.

Mr. C. C. Mallard, J. A. Dodson, J. W. Morgan, and Geo. C. Nutting, local committee, reported that they had met and made arrangements for holding the next annual Convention at the Kimball House, Atlanta, Ga., also for special entertainment features. The report was very satisfactory and was accepted.

The president was authorized to request a paper to be read by some gentleman at the next annual Convention.

Voted to hold evening sessions at the next annual Convention, if found necessary.

On motion, voted to make the regular salary of the official stenographer, Mr. W. C. Kikendall, $75 per annum, and the payment of the expenses of himself and wife at the Convention.

Adjourned to meet at the Kimball House, Atlanta, Ga., 7:30 p. m., Monday, October 14, 1901.

ABSTRACT OF MINUTES OF MEETING OF EXECUTIVE COMMITTEE HELD AT KIMBALL HOUSE, ATLANTA, GA., MONDAY EVENING, OCTOBER 14, 1901.

Meeting called to order by President Rogers at 9 o'clock p. m.

Members present, W. A. Rogers, W. G. Berg, S. F. Patterson, A. S. Markley, J. H. Cummin, C. C. Mallard, James Stannard, N. W. Thompson, and H. D. Cleaveland.

Minutes of last Executive Committee meeting read and approved.

Secretary presented his report to the committee showing the Association to be in a good financial condition and a large application list.

One member dropped from rolls on account of arrears for dues. Action in regard to nine other members in arrears postponed till next spring meeting of committee, the secretary being instructed not to mail copies of the Proceedings to such members unless dues are paid.

Mr. Berg moved that method of payment of bills by secretary as carried out during the last year, viz., contracting regular indebtedness and payment of same, subject to subsequent approval of the Executive Committee, be continued. Motion carried.

Mr. Cummin moved salary of secretary, Mr. S. F. Patterson, be $400 per year. Motion carried.

The abstract of minutes of the three meetings of the Executive Committee held during the year read and approved and ordered submitted to the Convention as the annual report of the Executive Committee. Minutes of present meeting read and approved.

Adjourned at 10:30 p. m.

S. F. PATTERSON,
Secretary.

President. — What shall be done with the report of the Executive Committee?

Mr. Markley (A. S.).—I move that it be approved and incorporated in the printed proceedings of the Convention.

Motion seconded and carried.

President.—We will now listen to the secretary's report which will be read by the assistant secretary.

Report read by assistant secretary, Mr. Pickering.

REPORT OF SECRETARY.

To the Association of Railway Superintendents of Bridges and Buildings:

GENTLEMEN: Your secretary submits the following report for the year ending Oct. 15, 1901: The Convention adjourned at St. Louis, Mo., Oct. 18, 1900, after a very profitable and pleasant meeting to meet at Atlanta, Ga., Oct. 15, 1901. President appointed C. C. Mallard, J. A. Dodson, J. W. Morgan, and George C. Nutting, a local committee to make arrangements for our Convention, securing hotel ac-

commodations, etc. At a well attended meeting of the Executive Committee at Chicago on Oct. 18, 1901, the local committee reported that they had attended to their duty and recommended the Kimball House for our accommodation, also features of entertainment were presented, which report was accepted and adopted, and the committee instructed to carry out their recommendation. Providence has smiled upon us and I am glad to say that the unwelcome messenger has not visited us during the year.

We note with sadness that Mrs. N. W. Thompson, wife of our worthy treasurer, met with a serious accident, falling and breaking her hip. We miss her cheerful face to-day, as she has always been with us at our conventions. Let us hope that she is on the road to full recovery. We have now on our roll 132 names and 35 applications to be acted on to-day. I am glad to say our Association is in a very prosperous condition.

FINANCIAL.

Dr.

Cash on hand, at last report	$228.13	
Cash received for dues and new members	348.00	
Cash received for advertisements	955.00	
Cash received for sale of books and tables	58.06	
Total		$1,589.19

Cr.

By cash paid out for which I hold vouchers	$1,356 59
Balance on hand	$222.60

Respectfully submitted,

S. F. PATTERSON,
Secretary.

Mr. Cummin.—I move that the report be received and spread on the minutes of the Association.

President.—If no objection, that course will be pursued. The next in order is the treasurer's report.

Treasurer's report read by Mr. Pickering.

To the President and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your treasurer submits the following report:

Cash on hand, Oct. 16, 1900	$719.51

All of which remains on hand.

N. W. THOMPSON,
Treasurer.

ATLANTA, GA., Oct. 15, 1901.

President.—Unless objection, we will receive the report, and have it spread upon the minutes as read. The reports of the secretary and treasurer will be referred to the Auditing Committee.

President.—The report of the Committee on Relief is the next in order of business, but we will omit this report for the present. The next order of business will be of interest to the secretary, the payment of annual dues, and we will take a brief recess for this purpose.

President.—The meeting will please come to order again and we will now have the report of Committee on Relief.

Report read by Mr. Pickering.

ATLANTA, GA., October 15, 1901.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your committee, appointed on relief at our last meeting which was held in St. Louis, Missouri, are pleased to say that during the past year there has not been an application for relief, which speaks well for the membership of our Association, and trust such prosperous conditions may always remain with us.

Respectfully submitted,

JAMES STANNARD,
W. M. NOON,
C. W. VANDERGRIFT,
J. H. MARKLEY,
Committee.

President.—What shall be done with this report?

Mr. Cummin.—I move it be approved and spread on the minutes.

Motion seconded and carried.

President.—The next order of business is the appointment of committees.

President.—At the spring meeting of the Executive Committee the president was ordered to appoint a Committee on Selection of Subjects, and the committee is as follows:

COMMITTEE ON SELECTION OF SUBJECTS.

Walter G. Berg, M. Riney, F. E. Schall, C. A. Lichty, H. D. Cleaveland, B. F. Pickering, W. O. Eggleston, W. M. Clark, J. B. Sheldon.

The president would ask this committee to formulate a report as to suitable subjects for report and discussion for our next annual Convention and report on this at some later session. The president would also appoint the following committees:

NOMINATING COMMITTEE.

James Stannard, Joseph H. Cummin, John Foreman.

AUDITING COMMITTEE.

Joseph M. Staten, Aaron S. Markley, A. McNab.

COMMITTEE ON RESOLUTIONS.

H. D. Cleaveland, Aaron S. Markley, A. E. Killam, C. P. Austin, H. Rettinghouse.

Mr. Markley (A. S.).—I move that we adjourn until 2 o'clock.

Mr. Cummin.—As we have twenty minutes more before noon, I think we had better use the time up until 12 o'clock.

President.—The assistant secretary will please read any communications that he has.

The assistant secretary thereupon read letters from the following members, expressing regret on account of their inability to attend the Convention:

W. E. Smith, W. A. McGonagle, S. S. Millener, A. Montzheimer, W. B. Yeareance, P. N. Watson, O. J. Travis, E. F. Wise, N. M. Markley, W. S. Danes, W. M. Noon, J. L. Soisson, A. C. Olney, Geo. W. Andrews, A. W. Merrick, L. D. Smith.

Mr. Stannard.—I move that we adjourn to meet at 2 o'clock p. m., sharp.

Motion seconded and carried.

AFTERNOON SESSION, TUESDAY, OCTOBER 15, 1901.

President.—The Convention will please come to order.

President.—The first order of business is the reading of committee reports. We have here the report of the Auditing Committee, to be read by the assistant secretary.

Report read by Mr. Pickering.

REPORT OF AUDITING COMMITTEE.

ATLANTA, GA., Oct. 15, 1901.

To the Association of Railway Superintendents of Bridges and Buildings:

We, the undersigned Auditing Committee, beg leave to present the following:

REPORT OF SECRETARY.

On hand, and dues collected	$576.13	
Sale of proceedings	58.06	
Advertisements	955.00	
Total received		$1,589.19
Expenses		1,356.59
Cash in secretary's hands, Oct. 15, 1901 .		$232.60

REPORT OF TREASURER.

Cash on hand, October 15, 1901 . . .	$719.50

J. M. STATEN,
A. S. MARKLEY,
A. MCNAB,
Auditing Committee.

President.—Gentlemen, what shall be done with this report?

Mr. Cummin.—I move that it be received and spread in full upon the minutes. Motion carried.

President.—If no further committee reports, will pass on to the reports of the Investigating Committees. The first committee report on subjects is No. 1, "Methods for Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under." The secretary has not received copy of that report, and I would ask if any of the members of this committee are present.

President.—We will pass it temporarily, and go to subject No. 2, "Passenger Platforms at Way Stations, Best Material and Cost of Same." Mr. Sheldon, will you please read your report?

Mr. Cummin.—To save time, would it not be well for the chairman of the committee to give a gist of the investigation without reading the full report? It would save a great deal of time, and we could then get at the discussions earlier.

President.—I think that would be a good idea, and those who have not copies of the reports, may obtain same by coming forward.

Whereupon Mr. Sheldon read a synopsis of his report. (See report on subject No. 2.)

President.—As I understand it, we leave the discussion of these reports until later on. The next is subject No. 3, "Slips for Ferry Boats used for Transferring Railway Cars." Mr. Isaacs is not here, but Mr. Cleaveland is, and I will ask him for the report.

Mr. Cleaveland.—I will state that I received a communication

from Mr. Isaacs, chairman, and I supposed from that communication that he intended to make out a full and complete report and present it to the Association, but I heard, incidentally, to-day, that the matter had been taken up so fully by the Maintenance of Way Association that Mr. Isaacs did not consider it advisable to send in a report to this Association.

Mr. Berg.—Mr. Isaacs is certainly qualified to make a very valuable and interesting report, and it may be that he has not been able to prepare a report on the subject, and I would therefore move that we discharge the committee. At the same time in order to leave the matter open, in case Mr. Isaacs has material collected, the secretary should be directed to ask him if he has the material and desires to present a report at the next meeting, and if so, that we will be glad to receive it in the form of a paper.

President.—I think that would be a very good idea. I was very much disappointed to find out a report would not be made on this subject, and I sincerely hope that Mr. Isaacs will embody the material in the form of a paper for us next year, and I trust the secretary will be able to induce him to do so. Gentlemen, you have heard the motion of Mr. Berg, and all in favor of it will please say aye.

The motion prevails, and the secretary is so instructed.

President.—Next subject is No. 4, "Best Method of Operating Turn-tables by Power." Mr. Schall is chairman and we would like to hear from him.

Mr. Schall presented a synopsis of his report and conclusions reached. (See report on subject No. 4.)

President.—The next subject is No. 5, "Auxiliary Coaling Stations; Best Design, Capacity, and Method of Handling Coal." We had a communication from Mr. McGonagle, chairman of this committee, read by the assistant secretary this morning, asking that his committee be permitted to have further time to make this report, and I think a motion should be made to continue his committee for another year.

Mr. Cummin.—I move this committee be continued for another year. I do not believe there is a member in this Association better fitted to handle this report than the present chairman.

Motion seconded and carried.

President.—This committee will be continued for another year.

President.—The next subject is No. 6, "Water Stations; Best Material for Foundations, Tanks, Substructure, Connections, Capacity," etc. Mr. A. S. Markley is chairman of this committee, and we will be glad to hear from him.

Mr. Markley (A. S.), chairman of the committee, then gave an outline of the report on water stations, etc. (See report on subject No. 6.)

President.—I see one of the members of the committee on subject No. 1, "Methods of Sinking Foundations for Bridge Piers in Depth of Twenty Feet and Under," is present. Mr. Lichty, have you anything to say?

Mr. Lichty.—No, sir, I have n't anything to say at all on that subject.

President.—Do you know whether they made a report?

Mr. Lichty.—There was a report being made, yes, sir, but I do n't know whether it was submitted to the secretary or not.

President.—I believe the secretary said that Mr. Andrews wrote him that he had been working on the report, but had not been able to get it out yet. Now what action shall the Association take with reference to this subject?

Mr. Markley (A. S.).—I know Mr. Andrews asked for information for this report as he wrote to several of the members, and I think he made up a report, though if it does not arrive in time for this meeting, I would suggest that we print it just the same as if received here in time. I move that Mr. Andrews be requested to complete his report in season to get it published in the Proceedings.

Motion seconded and carried.

President.—Next is subject No. 7, "Is it Best for Railroad Companies to Erect Their Own Steel Structures, or let the Manufacturers Erect Them?"

Report read by assistant secretary, Mr. Pickering. (See report on subject No. 7.)

President.—Next report is on subject No. 8, "The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang." I think this report was turned in to the secretary.

Secretary.—I received a letter from Mr. Merrick saying that he had mailed his report to me at Concord, New Hampshire. I left

word for it to be forwarded here; no doubt it will arrive before we get through. It might be well to pass over this subject until later on.

President.—The suggestion has been made that we discuss at this time this year's reports, and then after the discussion of this year's reports, while they are fresh in our minds, that we pass to last year's reports. It strikes the president that the idea is a very good one, and unless there is objection we will follow that plan, and in pursuance of this plan we will pass to the discussion of subject No. 1, "Methods of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under." Now we have in a measure put off that subject, but while we have no committee report, we might with profit, I think, discuss the subject in a general way for a few minutes, as it is one that is of interest to all of us, and we would be glad to hear from any of the members in the line of giving us ideas as to methods of sinking foundations for bridge piers, etc. (See discussion on subject No. 1.)

President.—If no further discussion on the subject of sinking foundations for bridge piers, etc., we will pass to the next subject, No. 2, "Passenger Platforms at Way Stations, Best Material and Cost of Same." (See discussion on subject No. 2.)

President.—The secretary states that before starting in on a new discussion he has some letters that should be read at this time.

The assistant secretary, Mr. Pickering, read telegrams and letters from various cities desirous of securing the annual Convention for next year.

Mr. Berg.—I would like to state that the Committee on Selection of Subjects will meet immediately after the adjournment of this session, and if any of the members have subjects that they would like to have considered, would be glad to have them come to the meeting and give us the benefit of their advice.

Mr. Stannard.—I move that we adjourn until 7:30 o'clock this p. m.

President.—You have heard the motion to adjourn. All in favor of the motion please say aye. The ayes have it, and the meeting will be adjourned until 7:30 p. m.

EVENING SESSION, TUESDAY, OCTOBER 15, 1901.

Meeting called to order by the president at 7 : 45 o'clock p. m.

President.—The first order of business will be listening to the report of the Committee on Programme or Selection of Subjects for Reports and Discussion to be presented at our next meeting.

Report of Committee on Selection of Subjects for Discussion read by Mr. Pickering.

ATLANTA, GA., October 15, 1901.

To the Association of Railway Superintendents of Bridges and Buildings:

The Committee on Selection of Subjects for Discussion presents the following subjects for reports and discussion at our next annual Convention, viz.:

1. Auxiliary coaling stations; best design, capacity, and method of handling coal.
2. Roof coverings, first cost, life, efficiency, and maintenance expenses for various classes of railroad buildings.
3. Mail cranes, first cost, efficiency, and maintenance of various styles in use.
4. Best method of protecting low overhead structures over tracks from gases and blast of locomotives.
5. What has been the experience in the use of concrete under bridge bed plates and turn-tables in place of pedestal stones, and what is the best form and material for bed plates under various styles of iron bridges?
6. Best design and recent practice in building railroad track pile drivers.
7. Best materials and design for roundhouse pits, including drainage and rail fastenings.
8. Best materials for wearing surface of roadway of highway bridge floors.

WALTER G. BERG,
M. RINEY,
F. E. SCHALL,
C. A. LICHTY,
H. D. CLEAVELAND,
B. F. PICKERING,
W. O. EGGLESTON,
W. M. CLARK,
J. B. SHELDON,
Committee.

Mr Markley (A. S.).—I move the report be received and the committee discharged.

President.—If no objection we will take that action.

President.—The next order of business will be listening to the report of the Nominating Committee.

Report of the Nominating Committee read by Mr. J. H. Cummin.

REPORT OF NOMINATING COMMITTEE.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your Nominating Committee would respectfully present the following report:

President.—Wm. S. Danes, Wabash R. R.
First Vice-President.—B. F. Pickering, B. & M. R. R.
Second Vice-President.—A. Shane, T., St. L. & K. C. R. R.
Third Vice-President.—A. Zimmerman, Col. & Southern R. R.
Fourth Vice-President.—C. C. Mallard, So. Pac. Co.
Secretary.—S. F. Patterson, B. & M. R. R.
Treasurer.—N. W. Thompson, P., F. W. & C. R. R.
Executive Members.—Arthur Montzheimer, C. & N. W. Ry.; W. E. Smith, C. M. & St. P. Ry.; A. W. Merrick, C. & N. W. Ry.; C. P. Austin, B. & M. R. R.; C. A. Lichty, The N. W. Line; W. O. Eggleston, C. & Erie R. R.

JAMES STANNARD,
JOHN FOREMAN,
J. H. CUMMIN,
Committee.

President.—What shall be done with the report of the Nominating Committee? Unless objection the report will be spread upon the minutes as read.

President.—Any further business? If not we will proceed to the reading of Mr. Andrews's paper on "The Use of Compressed Air," and I would ask the assistant secretary to read it.

Paper read by Mr. Pickering. (See paper.)

President.—Secretary Patterson has received several communications which we will have read by the assistant secretary.

Mr. Pickering then read a letter from Mr. Merrick, enclosing his report on subject No. 8, "The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang." Also a letter from Mr. Andrews regretting that up to the present time he had been unable to complete his report on "Foundations Under Water," but advised that he would send it in time to be printed in the Proceedings, saying that delay was caused on account of not being able to get sufficient data in time to make up a good report. Also a letter from Mr. A. C. Olney, introducing the new members from the Plant System, and expressing regrets on account of not being able to attend the meeting.

President.—Inasmuch as Mr. Merrick's report has been

received we will listen to it before adjourning. I will ask the assistant secretary to read it.

Report read by Mr. Pickering. (See report on subject No. 8.)

Mr. Cummin.—I move to adjourn until to-morrow morning at 9:30 o'clock, sharp.

Motion seconded and carried.

MORNING SESSION, WEDNESDAY, OCTOBER 19, 1901.

President.—It is now after 9:30, and the meeting will please come to order.

President.—In the absence of report on subject No. 3 we will pass to the next subject for discussion, which is subject No. 4, "Best Methods of Operating Turn-tables by Power." Mr. Schall of the Lehigh Valley is chairman. Mr. Schall, will you please open the discussion? (See discussion on subject No. 4.)

President.—The next subject is subject No. 5, "Auxiliary Coaling Stations; Best Design, Capacity and Method of Handling Coal." But as this subject has been carried over until the next meeting, we will therefore pass to subject No. 6, "Water Stations; Best Material for Foundations, Tanks, Substructure, Connections, Capacity," etc. Mr. A. S. Markley is the chairman, and we will have him open the discussion. (See discussion on subject No. 6.)

President.—We will pass to the next subject, which is No. 7, "Is it Best for Railroad Companies to Erect Their Own Steel Structures or to Let the Manufacturers Erect Them?" Mr. O. J. Travis is chairman, but is not here. Mr. Zimmerman, have you anything to say on this subject? (See discussion on subject No. 7.)

Secretary.—I have a few communications that I would like to have read at this time.

The assistant secretary then read three communications from parties at Cleveland, inviting the Association to come to Cleveland for their next annual Convention.

Secretary.—Before we adjourn I would like to announce that there are several parties here showing samples of goods, etc., and perhaps it might be of interest for all of us to call in their rooms. It is only fair and just that we should give these parties some attention as they have come here for our benefit as well as their own.

President.—There is quite a good deal more discussion, and we want to adjourn until 9 o'clock to-morrow morning.

Mr. Markley (A. S.).—I move that we adjourn until to morrow morning at 9 o'clock.

Motion seconded and carried.

MORNING SESSION, THURSDAY, OCTOBER 17, 1901.

President.—The meeting will please come to order. We still have one more subject for discussion, the report of Mr. Merrick's committee on subject No. 8, "The Best and Most Convenient Outfit Cars for Bridge Gang, and the Number of Men Constituting a Bridge Gang." Mr. Clark is the only member of the committee that I see here. Mr. Clark, will you please open the discussion on your committee report? (See discussion on subject No. 8.)

President.—Mr. Mallard has a few announcements to make at this time and we will listen to them.

Mr. Mallard then explained in regard to arrangements made by the Entertainment Committee for the trip to Stone Mountain, the "Georgia barbecue," tendered by Mr. Lemond and the ladies of Atlanta, and the special trip after the close of the Convention from Atlanta to Miami, Fla., and return.

President. — The discussion on subject No. 5 being closed, we will now go to the subjects of last year, and the chair would ask that you do not engage in a general discussion of these subjects. If any members have any data collected which they intended to bring up before this meeting, it would be desirable that they simply present it in a general way and let us pass on to the next subject.

Mr. Cummin.—Inasmuch as our time is limited as it is, I would suggest instead of going into a discussion of the subjects of last year, that if any member of the Association has any new points to bring out on these subjects, he send them in writing to the secretary to be incorporated in the Proceedings.

President.—You have heard the motion; are there any remarks?

Mr. Markley (A. S.).—The questions cannot be discussed by simply writing to the secretary.

Mr. Cummin.—That was not the motion at all. The motion was that if any member present had discovered or found out any

new points to bring up on the subjects of last year, to give us the benefit of that information by writing such matters to the secretary, so they may be incorporated in the Proceedings.

Mr. Berg.—Mr. President, the idea of bringing the subjects up again the second year is to give the members an opportunity, all during the year, to determine the merits of the reports and consider the discussions at the last meeting, and then bring up any new matter pertinent or directly bearing on the subject, without extending to a general discussion, as it very often takes up much valuable time and is simply a repetition of the details of the discussion of the previous year. I think it would be much more desirable to vote on Mr. Cummin's motion, and if any of the members have personally collected during the year some special data that they wish to call attention to, which is directly pertinent to the subject of last year, that they present it to the secretary in writing, to be embodied in our Proceedings of this year.

Mr. Stannard.—Question.

President.—You have heard the motion; all in favor of it please say Aye; those opposed, No. The motion prevails, and we will so act.

President.—The next order of business is the report of Committee on Resolutions.

Mr. Cummin.—There is one matter in connection with the resolutions to be submitted to the Association that I would like to refer to. I do not know whether it is a proper question to bring before this Association, but I myself do not think it is improper. It is in regard to a circumstance that occurred a few weeks ago, that not only thrilled the nation of the United States, but the whole world. I allude to the assassination of President McKinley. I do not believe in the history of the world can be found such wide, universal, and extended expressions of mourning and sympathy, not only among the people of the United States, but from every civilized nation on the face of the globe, as was expressed on this occasion, and it seems to me that it would be fitting for this Association, or the Committee on Resolutions, to present a resolution expressing the sympathy of this Association on that event. We might naturally ask ourselves, Why was this sympathy so universal all over the earth? It was not, in my opinion, because President McKinley was the chief executive officer of the

United States, but it was simply because William McKinley was a man, a man true, devoted, upright, and honest in every way, and I think it would be wise for us to adopt such a resolution as framed by the Committee on Resolutions, expressing the sentiments of this Association.

Report of Resolution Committee was then read by Mr. Cleaveland. (See report of the Resolution Committee.)

REPORT OF COMMITTEE ON RESOLUTIONS.

Mr. President and Members of the Association:

The Committee on Resolutions has the following report to offer:

Resolved, That the thanks of the Association be tendered to Governor Candler for his most hearty welcome, not only to the city of Atlanta, but to the state of Georgia.

Resolved, That the thanks of the Association be forwarded to Mr. T. E. Kinsey, Supt. of the Pullman Co., Atlanta, Ga.; J. A. Dodson, Gen. Supt. Southern Ry., Chattanooga, Tenn.; W. B. Denham, Gen. Supt., and W. J. Haylord, Supt. Trans., of the Plant System, Savannah, Ga.; R. T. Goff, Gen. Supt. of Florida & East Coast Ry., St. Augustine, Fla.; Mr. Magill, Loc. Agt., and Mr. Robinson, Supervisor, of Georgia Ry., who have all extended courtesies to the members of the Association.

Resolved, That we appreciate the attendance at this meeting of representatives of the following papers: *Railway Review*, *Railway Age*, *Railroad Gazette*, *Railway Herald*, and *Common Carrier*.

Resolved, That the thanks of the Association be extended to J. S. Lemond, J. W. Lovett, and the ladies who have provided local entertainment to the members and their ladies, and to Mr. C. C. Mallard for his untiring efforts in behalf of all; also, to those who furnished us with the most enjoyable and novel entertainment in the shape of the "Georgia barbecue," which received the highest praise from all.

Resolved, That the thanks of this Association be extended to Geo. W. Andrews for his most excellent paper.

Resolved, That we, as members of this Association, representing all parts of our country, feel that before separating we would like to express our deep regret at the calamity that befell our country in the sad affair that happened in Buffalo a few weeks ago, in the assassination of our beloved president. We feel that this is not only a loss to our own country, but to the world, as there are but few men with the strong character and with all the simple and lovable characteristics of William McKinley, and the world can ill afford to lose him.

Resolved, That the thanks of this Association be extended to the retiring officers and members of the Executive Committee for their untiring efforts and the most satisfactory way in which they have conducted the business of the Association the past year, and to all others who have rendered service or entertainment in any form.

Respectfully submitted,

H. D. CLEAVELAND,
C. P. AUSTIN,
A. E. KILLAM,
H. RETTINGHOUSE,
Committee.

Mr. Cummin.—I agree with those resolutions, particularly in one respect, and that is, the position taken by Messrs. Lovett, Mallard, and Lemond. Mr. Mallard has virtually excluded himself from all meetings of this Convention for the benefit of our members, and Mr. Lemond and Mr. Lovett have both done so in a great measure themselves, and I think they certainly deserve the thanks of this Association for their untiring efforts.

Mr. Berg.—I move the adoption of the report of the Committee on Resolutions.

Mr. Clark.—I second that motion.

President.—All in favor of the motion please say aye. The motion is carried.

President.—Are there any other committee reports? If not, we will pass to the order of unfinished business. Have you any unfinished business?

Secretary.—Nothing, sir.

President.—The next order of business is new business. I should say that under that we might take up the question of our next annual Convention. The location and nominations for the next Convention city are in order.

The following cities were then nominated as places for holding the next annual Convention of the Association: Boston, Minneapolis, and Quebec, and upon ballot being taken Minneapolis received twenty-three votes, Boston ten, Quebec two, Cleveland one; total, thirty-six.

President.—Minneapolis, having received a majority of the votes cast, is to be our next meeting place.

Mr. Pickering.—I move that we make this selection of Minneapolis unanimous, and that every one of us enter as heartily and as earnestly into the business of making the next Convention the most successful we have had as though Minneapolis had been our first choice.

Motion seconded and carried, and Minneapolis was then made the unanimous choice of the Convention.

A letter was then read by the assistant secretary, Mr. Pickering, from Mr. Wm. S. Danes, expressing regrets at not being able to be present on account of important work on hand that he could not leave.

Secretary Patterson.—In connection with this, I would say

that in answer to an inquiry from one of the members of the Association, the following telegram has been received from Mr. Danes:

PERU, IND., Oct. 17, 1901.

If elected president, will attend to the official duties to the best of my ability. It was impossible to attend the meeting, account new work on hand this year.

(Signed) WM. S. DANES.

Mr. Berg.—Our date of meeting is specified in the by-laws as the third Tuesday in October of each year, still I believe that we could change the date by a majority vote of the meeting, without previous notice, as would be required in the case of a constitutional amendment. I bring this up now because in conversation with members I have found that there is some difference of opinion, and while probably the result of a vote may indicate that October is the better month, I think no harm would be done to take a vote. Personally, I think October is not the most desirable month. On account of approaching winter a great many are anxious to get work done, or work has just been started at the last moment, and, further, the number of excuses that we get at each meeting, in regard to members not being able to be present, on account of inspection trip, indicates that the month of October is a busy inspection month on a great many railroads. I therefore move that the third Tuesday in September should be the date of our next meeting.

President.—The motion has been made and seconded that the date of holding the annual Convention be changed to the third Tuesday of September. Are there any remarks?

Mr. Rettinghouse.—I wish to call your attention to the fact that the roads in our part of the country hold their inspections in the month of September; at least, it is so on the North Western. On account of the severe climate the inspection is made in the month of September instead of October.

Mr. Lichty.—I believe the state laws of Iowa and of other states that the North Western runs through requires the bridge inspection to be made in the month of September. I have written a number of members this year, and their reply was that they could not get away; on account of having their inspection they are much busier in September than in October.

Mr. Berg.—I desire to say that we also ought to take into consideration the fact that we have always met in the month of October for the last ten years, but I thought the subject one to bring before the members, as it might be that the idea prevails that we could not change the date of the meeting, and for that reason I brought up the question.

Mr. Stannard.—When we organized we took all these things into consideration. We discussed the matter thoroughly at St. Louis, and also by letter before we met, and the majority of the charter members favored September 25. I favored September 25, but when they got together in St. Louis, they made it a little later, the third Tuesday in October, and I think it would be very much better to leave it just as it is.

Mr. Markley (A. S.).—Personally, it does not make a bit of difference to me, and I know Mr. Berg's idea is simply to accommodate the majority of the members. This year I know of no member absent on account of inspection only on the Big Four, and one or two others. Aside from that I do not know of any that interferes with the inspection trips.

President.—If no further remarks, we will proceed to vote on this question. All in favor of same will please say aye; those opposed, no. The nays have it, the motion is lost, and our meeting time, therefore, will remain the same as at present.

Mr. Cummin.—There is one subject I desire to bring up. It is a subject that has been spoken about to me by a number of members since we came to Atlanta. Article VI of our constitution says: "The Executive Committee shall exercise a general supervision over the financial and other interests of the Association, assess the amount of the annual and other dues, call, prepare for, and conduct general or special meetings, make all necessary purchases and contracts required to conduct the general business of the Association," etc. Some years ago our dues were $2.00, but it was found that our finances were running low, and at a meeting of the Executive Committee of the Association it was decided to increase the dues to $3.00 a year, but I think we now stand on a strong financial basis, and a number of the members have come to me during this meeting and stated that they could not see any advantage in our accumulating a large amount of money. Neither do I. If we have enough to run this Association on a good square

footing we would not require $1,000, $2,000, or $2,500 balance in the treasury, and, while the power, as stated before, comes in the hands of the Executive Committee and I am a member of that committee, still I think it would be advisable to get a short expression from the general membership of the Association, so that the Executive Committee can be guided by their views as to reducing the dues to $2.00 a year.

Mr. Stannard.—I am in favor of giving the members the benefit of everything that we can, and if we can reduce our dues to $2.00 instead of $3.00 I think we should do so, provided we do not cripple the treasury.

Mr. Sheldon.—It seems to me that if the opinion of the Executive Committee is that the financial condition is such that the dues can be reduced, they are at liberty to do so.

Mr. Lichty.—I agree with the remarks made by the gentleman.

President.—We have $1,000 surplus on hand, and stand little risk by reducing our dues.

Mr. Berg.—I move the discussion be closed, and that the matter be left in the hands of the Executive Committee.

President.—All those in favor of that motion please signify it by saying aye; those opposed, no. The motion is carried.

Mr. Berg.—I would like to call attention to the feature observed in publishing the Proceedings of the meetings of this Association that it is perfectly proper, as per resolution adopted heretofore by the Executive Committee and spread upon the minutes, for any member who desires to present a written discussion to the secretary on any subject that has been up at this meeting. I mention this because it may not be generally understood by the members that they have this privilege; such written discussions to be mailed to the secretary within the next four or five weeks, in time to be printed in the Proceedings, and we will be very glad to receive them.

Mr. Clark.—Would like to ask in regard to the Proceedings of this Association since its conception, if there are copies of the Proceedings in the secretary's hands, that is, the entire Proceedings.

Secretary.—I have a full set, the property of the Association. I also have extra copies for sale of all Proceedings, excepting Nos. 3 and 4.

Mr. Cummin.—For the information of Mr. Clark, I would state

that all our Proceedings for the first six years were published by the "Roadmaster and Foreman" in book form. They charge $2.50 a copy for same, and subsequent to the first six years copies can be purchased from the secretary.

President.—We will now proceed to the next order of business, which will be the election of officers.

Mr. Cummin.—If there are no other nominations in addition to those presented by the Nominating Committee, I move that the secretary be instructed to cast one ballot for all the names presented by the Nominating Committee.

Secretary.—I move that the chairman of the Nominating Committee, instead of the secretary, be instructed to cast the ballot.

Mr. Berg.—I second that motion.

President.—It has been moved and seconded that the chairman of the Nominating Committee be instructed to cast one ballot for all the names presented in the report of that committee. All in favor of that motion will please say aye. The motion prevails, and I will ask the chairman of the Nominating Committee to comply with the motion.

Mr. Stannard.—The ballot is cast.

President.—The ballot has been cast for your officers for the ensuing year, and you have elected the following officers, as per the report of your Nominating Committee, viz.:

President.—William S. Danes.
First Vice-President.—B. F. Pickering.
Second Vice-President.—A. Shane.
Third Vice-President.—A. Zimmerman.
Fourth Vice-President.—C. C. Mallard.
Secretary.—S. F. Patterson.
Treasurer.—N. W. Thompson.
Executive Members.—Arthur Montzheimer, W. E. Smith, A. W. Merrick, C. P. Austin, C. A. Lichty, W. O. Eggleston.

President.—In the absence of your newly elected president, I take pleasure in introducing Mr. B. F. Pickering, our new first vice-president. I thank you, gentlemen, for your kindness to me during the present session.

Mr. Pickering.—Gentlemen, I thank you for your kindness and your courteous treatment of me since I have been a member of this Association, and I am sure that in behalf of my dear friend, who has been selected as your chief for the next year, I can extend to you his hearty thanks. I am somewhat embarrassed in this

position, as it is entirely unexpected to me. Yet you, I think, understand that each one of us is supposed, whatever place we are put in, to do the best we can according to our ability for the good of the Association, hence I am here for service, and I assure you that the next year's work on my part shall be as earnestly and heartily performed as any year's service in the past. I trust we will all work diligently and earnestly together for the success of the Association for the next year. (Applause.)

First Vice-President.—I believe it is customary to secure the acceptance of the officers elected. Mr. Shane being absent, Mr. Zimmerman do you accept the office of third vice-president?

Mr. Zimmerman.—Yes, sir.

First Vice-President.—Mr. Mallard, you have been elected to the office of fourth vice-president, do you accept?

Mr. Mallard.—Yes, sir.

Mr. Cummin.—I think several years we had him in line for president and then he dropped out, very much to the regret of every member of the Association who knew him, and I am glad he has got into line again.

Mr. Mallard.—I thank Mr. Cummin for his very kind words. I went out of the bridge business, practically, and did not feel, under the circumstances, that I ought to accept the position, but as Mr. Berg says, once a member of the Association always a member, though I have not, at present, actual direct charge of bridges.

Upon inquiry by the first vice-president, all of the other members present who were elected to the various offices stated that they would accept their respective positions.

Secretary Patterson being called upon for a speech responded as follows:

Secretary.—Mr. President and Gentlemen, you all know by this time that I am no kind of a speech maker. I appreciate the honor you have conferred on me and wish to say that it shall ever be my desire to do my best work for the good of the Association. I appreciate the honor and the kindness you have shown me, for this is the tenth year I have acted in this capacity, and I assure you that while I cannot say it is an easy job, I can say that I have enjoyed it, and have attended to the work with great pleasure. I trust we will continue to make our Association a success, and in

regard to the present meeting, we can say truly that it is the best one we ever had. I thank you for your kindness.

Mr. Berg.—I desire to record my conviction, obtained from my experience with quite a large number of railroad societies that I am familiar with the workings of, that I have noticed an association rises and falls according to its secretary. Without a secretary devoted to the interests of the Association with unfailing industry and constant attention to all the many details, so as to guide the business of the Association through the year, the Association would be a failure. I think we ought to remember that the success of our Association is largely due to the industry and untiring efforts of our present secretary.

Mr. Berg.—I move that the president be requested to appoint in the list of committees, a committee on selection of subjects for discussion at next year's meeting. I think it desirable to cause the president to select such a committee and have their names published with the regular Proceedings so that the committee can during the year correspond with members and formulate a certain programme on subjects, to be supplemented by a larger committee next year. I think a small committee, say of three members, who are workers, and who will probably all or the majority of them be at the next meeting, should be appointed on this committee during the year and then that committee to be filled out by such members as are present at the next annual meeting. For in that way these two or three members during the year could correspond and get together a list of subjects for the consideration of the full committee at next session. I think the arrangement would give better results. This year the committee only appointed at the Convention met and we had quite a good deal of trouble trying to find suitable subjects, as we had such a short notice.

First Vice-President.— Do you make that a motion?

Mr. Berg.—Yes, sir, I make that a motion, that the president be requested to appoint such a committee.

Motion seconded and carried.

First Vice-President.—I am requested to announce that there will be a meeting of the Executive Committee in the secretary's room, at 7:30 o'clock this evening. All members of the Executive Committee are requested to be present.

Mr. Stannard.—If nothing further, I move that we adjourn to meet in Minneapolis on the third Tuesday of next October.

Mr. Berg.—I second the motion to adjourn.

First Vice-President.—Gentlemen, if no other business, you have heard the motion before the house for the adjournment of this Convention to the third Tuesday in October, 1902. All in favor of same please manifest by saying aye, and those opposed nay. The motion prevails, and this Association will now adjourn to meet in the city of Minneapolis, Minn., on the third Tuesday of October, 1902.

S. F. PATTERSON,
Secretary.

COMPRESSED AIR.

ITS USE AND ADVANTAGES.

BY GEORGE W. ANDREWS,

Supt. of Bridges and Buildings, Baltimore & Ohio Railway.

The use of compressed air in large shops is too well known to need much criticism; by its use mechanics have demonstrated its utility in both construction and repairs of various kinds of machinery, in the operation of the various cranes and hoisting appliances of the shops, in fact, its powers are almost unlimited. If this is so for shops why not equally useful for field work?

Having seen its advantages in shop work, and knowing that it had been extensively used in erection, the writer having a large amount of bridge work to do (principally strengthening) asked for a plant sufficiently extensive to demonstrate its practical utility. The request was granted, and the result has proven the move a wise one. That others, with similar work, might profit by the experience gained, I will endeavor plainly and practically as possible to give a description of the necessary plant and tools for an outfit for general bridge and field work.

It will be noted that the plant I describe is one operated by steam, and some will no doubt ask, Why not use a gasoline plant? This, of course, is optional, but the writer prefers the steam, reasons for which it is not necessary to state in this paper.

The plant I have in operation consists of an air compressor, capacity 95 feet of free air per minute, a 25 horse power boiler, a water tank of 300 gallon capacity, and an air receiver of 150 pounds capacity. This plant is mounted on a car as shown on plan. When in use the car is placed on a side track as near as possible to the bridge on which the work is to be done; $\frac{1}{4}$ or 1 inch wrought pipes are then connected to the air receiver or reservoir, and run to the bridge. At intervals along the bridge,

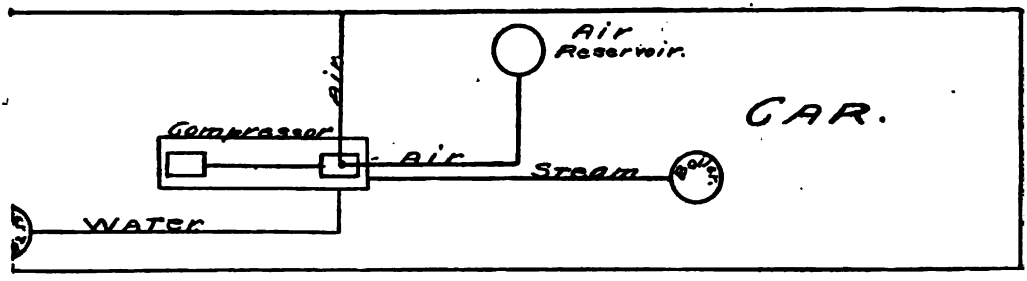


FIG. 1.—Plan for Air Compressor Plant.

hose connections and globe valves are placed in line of pipe for connections to various tools. The tools ordinarily used consist of drills, riveting hammers and chipping hammers; forges can also be arranged to be operated by the air. In operating care must be taken to occasionally blow out this pipe to prevent the accumulation of rust or dirt. Good wire-bound rubber hose should be connected to the pipe for tool use, as flexibility is required for moving tools from point to point.

In locating the plant for operation, it is necessary to consider the water supply, as considerable of this is needed, not only for the boiler, but for the cooling of cylinders of air compressor. This is just as important where gasoline or gas engines are used. For this purpose I have installed with the plant a small steam pump which can be set up at the nearest stream, spring, or well, and 1-inch pipe run to the car on which the compressor is installed, and by this means an ample water supply can be furnished at small cost. Steam for operating this pump is supplied from the boiler operating compressor.

Of the tools used, there are a number of various manufacture in the market, all of which possess more or less merit. The kind I have in use are as follows:

Little Giant Air Drill Press.
Boyer short stroke riveting hammer, No. 0.
" long stroke riveting hammer, (the new long stroke.)
" chipping hammer, No. 1.
" yoke hammer.

(For ordinary work would not recommend the purchase of the latter.)

In the drill press, Morse twist drills are used, the shanks of the various sized drills being made to fit the press. For chipping hammers, cape chisels, etc., blanks are furnished by the manufacturers to be made up into the style necessary, or the same can be made in one's own shop. The style of tools necessary will be developed by the class of work to be done. As before stated, the plant should be placed as close to the work as possible. This is, however, only as a matter of economy in the running of pipe.

I have operated it as far as half a mile from the bridge on which work was done. A plant such as I have described, exclusive of the air pipe for conveying air from plant to bridge, will cost about $1,600 (sixteen hundred dollars).

The cost of operating a plant of this character depends in a great measure on the foreman in charge of the work. The man in charge of the plant should not only see to the proper firing of boiler and running of compressor, but should do the drilling, or assist in same, for all work such as plates, angles, etc., that can be done at car. By doing work of this kind, the actual expense of man for running plant will be reduced at least one half. The amount of coal used will approximate about one quarter ton per day. Ordinary repairs to compressor can be made by the gang in charge.

In the eighteen months that our machine has been in use the repairs have been very slight, and machine is still in excellent condition.

For the drills and riveting hammers the expense is heavier, but as extra valves are supplied, and of which at least two should be carried in stock, there need be no delay in loss of tools while waiting for repairs, as the workmen soon become skilled in the handling of the tools, and can make all ordinary repairs, such as replacing valves, etc.

I have been asked by many where I found economy in a plant costing sixteen hundred dollars, and which could only be used by one gang at a time; this I answer by claiming the same superiority of this method over the old slow plodding use of hand drills, as the steam hammer is above the hand hammer and anvil, as the use of air in large shops is above the old method of hand work for every purpose, as the electric motor is above the horse car. I might continue on through all the improvements of the age were it necessary to clinch the argu-

ment, but as the work of a man or machine is their best argument, I only need point to that in this case.

In the use of air drill we find that two men can, under ordinary conditions, drill from five to six holes to one by hand by the same number of men. The drills can be used under ordinary conditions wherever hand drills can be used.

In riveting two men will, under ordinary conditions, do the work of three men with hand tools. As is well known by all bridgemen, we use, as a rule, three men besides the heater, for riveting, one to hold on, two to drive. With the pneumatic hammer, one to hold on and one to drive is all that is necessary. An additional advantage in this tool is that any intelligent helper can be taught the use of it by a skilled foreman in a day, whereas, under the old hand method, skilled riveters must be employed. Of course this method like the hand driving must be watched to avoid loose rivets. My experience in this has taught that up to $\frac{7}{8}$ rivets, this method is not only effectual, but highly economical.

In the handling of this plant it must not be overlooked that after drilling and riveting on large jobs are completed, there is still another use for the compressor. It is a well known fact that in painting bridges, one, if not the most expensive, is the cleaning of the metal before applying paint. By having a sand blast machine, of which there are a number in the market, attached to outfit, bridges can be cleaned in not only less time but much better. Personally, I have not used a machine of this kind, but have seen it used elsewhere, notably the 155th street viaduct, New York city. I am now in communication with a manufacturer of sand blast machines with a view of adopting it in manner described.

In conclusion I have a few suggestions to offer:

1. That anyone having a large amount of field work in which there is considerable field drilling and riveting to do, should beyond doubt install a plant of this kind.

2. That all who are inclined to doubt and who have sufficient work to justify it, should either try the method or see it in practical operation before condemning it.

3. That if the manufacturers would reduce their apparent exorbitant prices for drills, hammers, and repair parts, many more would be in use.

4. That as this is an age of advancement and progressiveness, and one in which no man can remain inactive, and at same time keep abreast of his fellow-workers, it behooves all to watch carefully the improvements in their special line, and grasp all possible opportunities for the economical handling of their work, as well as relieving their employés of unnecessary laborious duties.

COMMITTEE REPORTS FOR 1900-1901.

PRESENTED AT THE

ELEVENTH ANNUAL CONVENTION, ATLANTA, GEORGIA, OCTOBER, 1901.

I.—Methods of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under.

To the Members of Association of Railway Superintendents of Bridges and Buildings:

Gentlemen:—Your Committee on Best Methods of Sinking Foundations in Depth of Water Twenty Feet and Under, respectfully submit the following report:

Preparatory to drawing up a report, a circular was sent out to a number of members by the chairman of your committee, drawn in personal form, as follows:

"Dear Sir:—As you are aware, I am chairman of committee on best methods for placing foundations in water for depth of twenty feet and under. I have gone into this pretty deeply, and can find nothing better than the old reliable coffer dams, or for very shallow water, a dam made of sand bags, and the interstices filled with clay and gravel.

"I would like very much to have your views on this subject, that is, what do you consider the most practicable and economical method for keeping out water during excavation, and construction of masonry?"

To this circular a number of answers were received stating that the circular fully stated their views, that is, the most economical method was the ordinary coffer dam, as shown on print "A." Replies were also received from members showing different methods, all of which possess merit, and will be found appended to this report.

The Pennsylvania Railroad Company are at this time building bridge piers in the Schuylkill river at Philadelphia, just west of their Broad Street station.

For this work the ordinary coffer dam is being used in depth of water of about twenty-five feet.

The mass of opinion on this subject, both for utility and economy leans to the coffer dam, puddled with a mixture of gravel and clay. The old opinion in the puddling of coffer dams was that clay alone should be used, but experience has found this to be erroneous. It has been found that though clay may be tighter at first, the least leakage will wear a larger hole, and the clay being packed hard, will not fill up the opening, but on

"A"

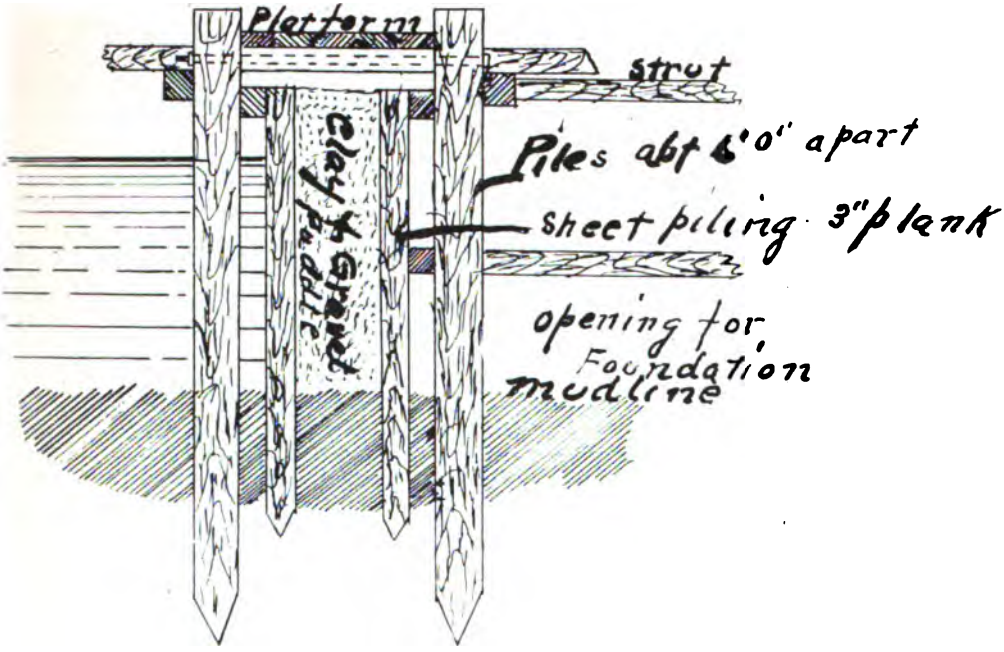


FIG. 2.—Ordinary Coffer Dam.

the other hand with gravel mixed with clay, if a small opening is made by water, the gravel will gradually wash into it and close it.

The method of sand bags mentioned in circular, consists of old cement bags filled with sand and piled around the opening for pier or foundation ; after these are laid as close as possible, gravel and clay is banked up on both sides. For depths of five

"C"

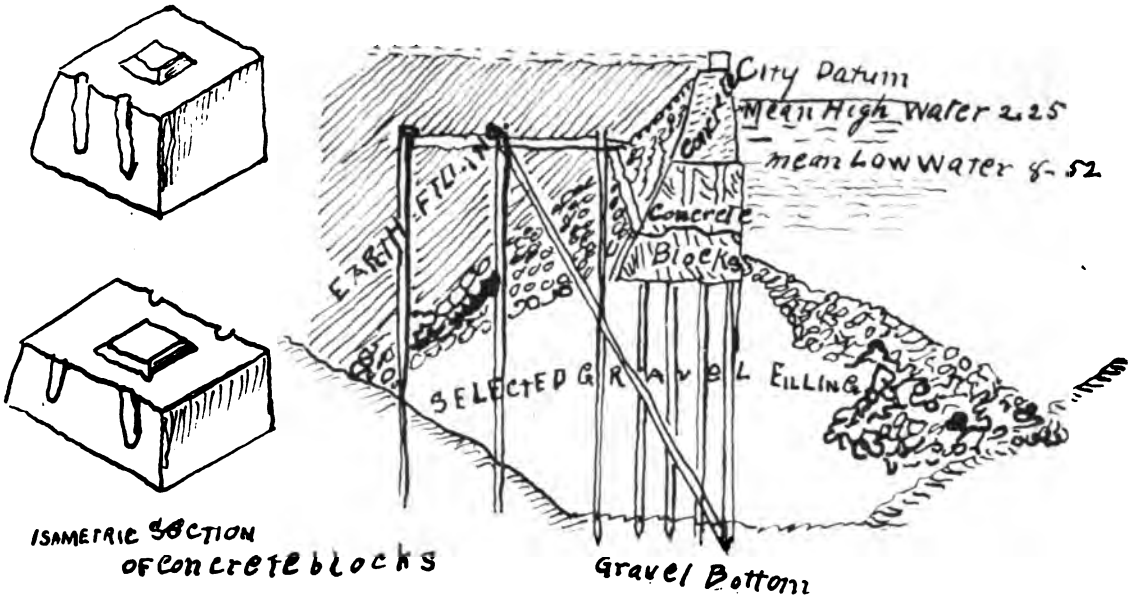


FIG. 3.—Department Public Works, Philadelphia.

feet or less, in moderately smooth water, this has been found very effective. If care is taken in the puddling, this can be made thoroughly water tight, and for shallow water it is much more economical than the timber dam.

The chairman of this committee has been using this method in light and shallow streams for the past fifteen years, and for such work as named heartily recommends it.

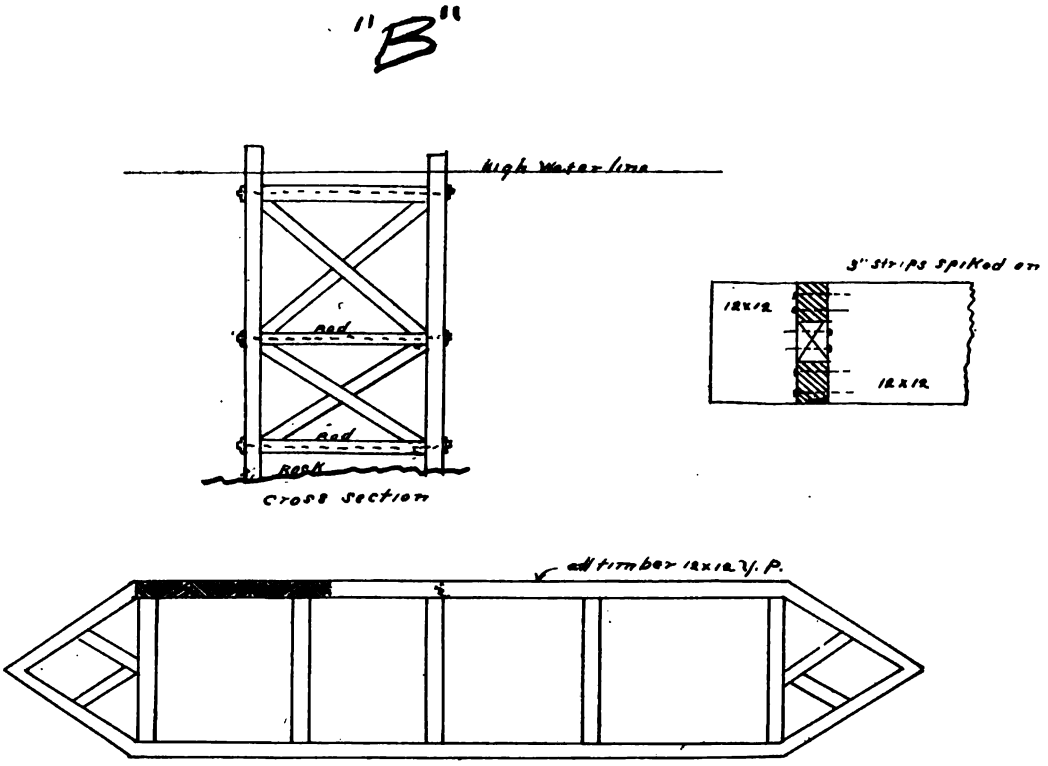


FIG. 4.—Coffer Dam as used at Walnut St. Bridge, Philadelphia, Pa.

The method used by the Department of Public Works of Philadelphia, in the construction of that portion of the Delaware river bulkhead from Vine street to South street, is well worth considering for foundations under water where coffer dams are impracticable. The following description is taken from the Twentieth Annual Report of that Department:

"A bank of selected coarse gravel with outer slope faced with rip rap dumped on the site; after the soft river was dredged,

piles were driven through the gravel and sawed off about twelve feet below water; three rows of additional drag piles, to which batter piles are secured; concrete blocks below low water line, with a width of twelve feet at the base, set on top of

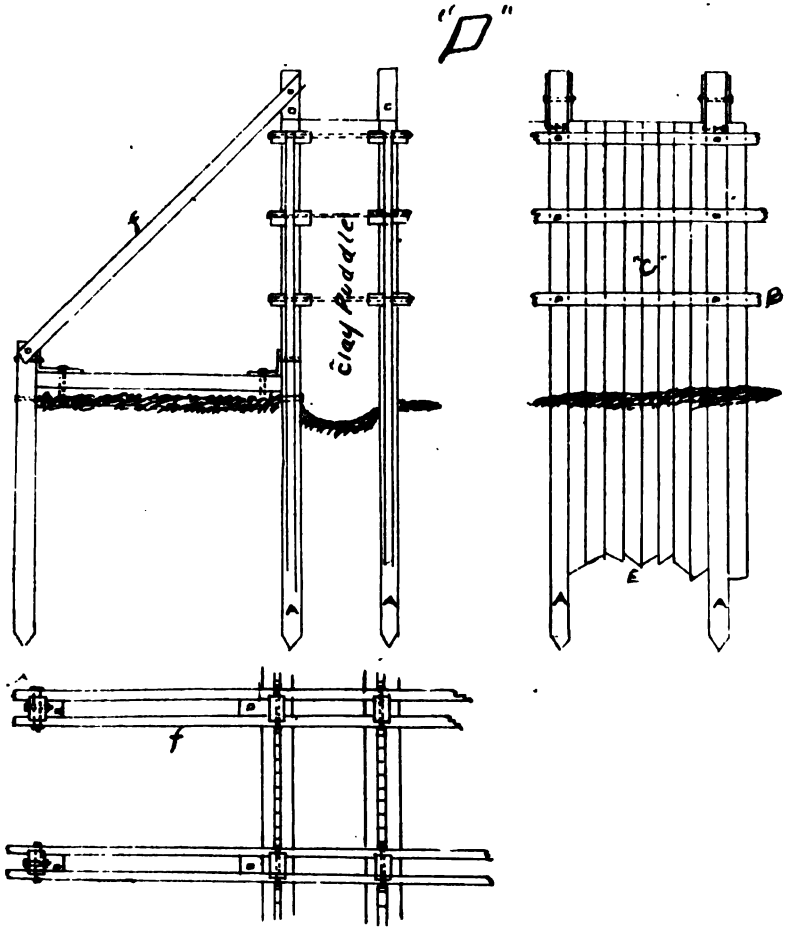


FIG. 5.—An English Coffer Dam.

piles, and even bearing was obtained by placing a cement mattress on the head of the piles; concrete wall formed in place from low water line to an elevation of plus 2 feet 5 inches. The concrete blocks were made of machine-mixed concrete, formed

in steel molds and set in place by a two-legged pivoted shear or 'A' frame set on a scow. The skeleton forms for making the concrete wall above low water were set directly on the blocks and sheathed with planed boards, against which the concrete was rammed, the joints between two sections being formed by two thicknesses of tar paper."

This construction is shown on sketch "C."

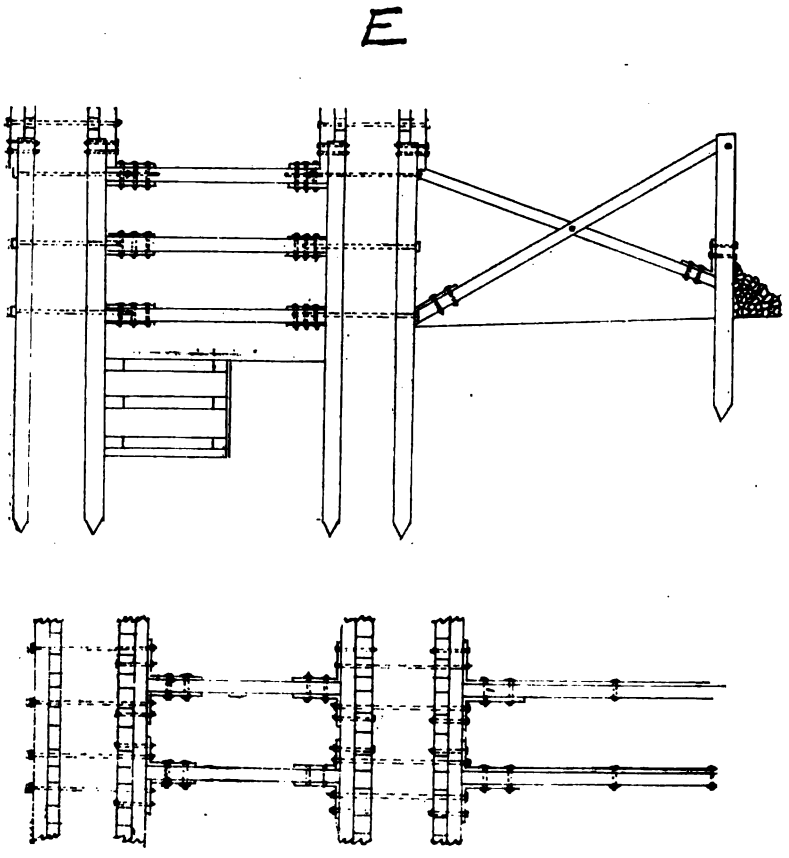


FIG. 6.—An English Coffer Dam.

In 1891 the city of Philadelphia built a bridge across the Schuylkill river at Walnut street, and in building the piers they started with what is known as the Robinson cylinder caisson; this consisted of 12 x 12 tongued and groved timber as sheet piling, driven close, and in circular form, then banded together

with iron plates from two to three feet wide. After having this washed away twice, they abandoned that method and adopted the plan shown on sketch "B," using the same timber as originally used on the circular caisson. Three piers were erected with this style of dam. Three sketches are attached showing some of the different styles of coffer dam in use in England. "D" is style of dam used in soft bottoms, and where the head of water is not great. The gauge piles "A" are

"F"

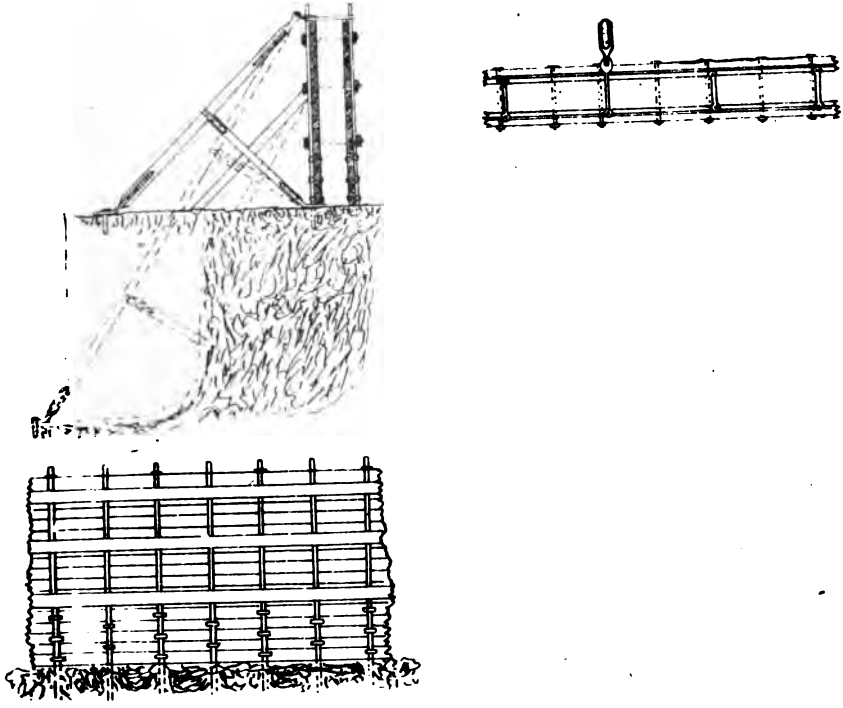


FIG. 7.—An English Coffer Dam.

driven at distances of from four to eight feet, to which wallings "B" are fixed; between these sheet pilings "C" are driven. The sheet piles are shod with iron, having a sloping edge to cause the piles to cling while being driven.

In the centre of each bay there is a key pile, having a slight taper, which on being driven down compresses the sheeting firmly together.

"Sketch 'E' is style of dam used in construction of Thames embankment, where the water pressure was great. This consists of an outer and inner dam of 2 rows of closely driven piles, with intervening spaces of 6 feet, filled with clay puddle. The dams were supported by stays abutting on firm ground, or where this could not be done, dwarf piles were driven deep enough to afford sufficient resistance."

"Sketch 'F' shows coffer dam designed by Mr. D. Stevenson, which is specially adapted to a hard bottom where piles cannot be driven. It is formed of two rows of iron piles placed three feet apart and jumped into the rock, which supports two linings of planking, the intermediate space being filled with puddle, and the whole structure properly stayed.

"This dam has been successively employed on a number of works, and to a maximum depth of 13 feet 6 inches. On the ribble excavation the maximum depth at high water was 16 feet, in high river floods the whole dam was submerged, but when water subsided the iron rods, although only 15 inches in the rock, were not drawn from their fixtures."

The last three methods are mentioned in detail for the reason that they are but little known to most of our members, and it is believed they possess sufficient interest to form part of this report.

In the appendix to this report will be found several methods of more than passing interest to not only the members of this Association but to all interested in this class of work. Among some of the novel methods that have been suggested to your chairman during the search for information on this subject, the following is one that deserves more than passing notice: First, a wrought-iron pipe about 6 inches in diameter, perforated with holes and driven through the soft bottom to gravel or rock, then hydraulic cement forced into the pipe under sufficient pressure to force it out into the mud, this to be done at sufficient intervals as to ultimately give a solid cement bottom.

This is inserted for the reason that it was a novelty to your chairman, and may be so to others.

In designing coffer dams, Professor Rankin, in considering the matter of resistance to water pressure, gives the following formula for calculating the pressure which the struts may have to bear:

"Let b = breadth in feet of the division of the dam sustained by one strut.

X = the depth of water in feet.

W = the weight of a cubic foot of water in pounds.

P = the pressure of water against that division of the dam.

Then $P = wbx^2 \div 2$.

And the moment of that pressure relative to a horizontal axis at the level of the ground is $M = wbx^3 \div 6$.

Let h be the height above the ground at which the strut abuts against the dam, and I its inclination to the horizon, the

thrust along the strut T = M sec ; I ÷ h, from which the scantling required can be calculated.

In conclusion we would recommend to those who desire to go deeper into the subject the reading of Baker's Treatise on Masonry Construction.

G. W. ANDREWS,
C. C. MALLARD,
C. A. LICHTY,
C. W. GOOCH,
C. S. THOMPSON,
D. ROBERTSON,
Committee.

APPENDIX TO SUBJECT NO. 1.

Mr. Robinson.—As one of the committee appointed to report on the following subject: "Method of sinking foundations for bridge piers in depth of water twenty feet and under," I beg to submit the following:

I recognize this as a very broad question, admitting of many solutions, as the conditions vary in every place. In no two places have we been able to follow exactly the same methods. I have also found, in my experience here, that in very few cases have we found a good natural foundation at a depth of twenty feet. We have constructed some piers in places where there seemingly was no bottom at all. We find that the cross sections of a stream under some of our bridges are very variable, and the question of probable scour is not an easy one to solve.

In general I am in favor of a pile foundation with concrete mat, or when possible to do away with the piles, to place the concrete directly on the natural foundation. In the lesser depths of water we generally use sheet piling. After driving our foundation piles (if necessary) we drive short piles at the corners of what we intend using as a base of the pier. These piles we cap. With this as a form we drive dove-tailed sheet piling, as nearly water tight as possible, forming the size of our pier base.

The water is pumped out, and if necessary the ground is excavated to a depth of at least 8 feet below low water. An 8-inch centrifugal pump will keep the water out in most cases. The foundation piles are then cut off at least 5 feet below low water, and the concrete put in. The mat extends down 3 feet below the cut off and up to low water line. Concrete is well tamped around the piles. If there is no base for the mat of concrete to rest on, rubble is dumped in around the piles to fill up to bottom of mat.

The general arrangement of sheet piling is shown on Plate 1, Figs. 2 and 3. Fig. 2 also shows the mat. We use from 4 x 12 inches to 7 x 16 inches for sheet piling according to depth. The dove-tailing is made by beveled strips 1 inch thick on the edges of sheet piling, as shown on Fig. 1, Plate 1.

As stated before, the "mat" usually extends up to low water, where the pier proper is started. This gives us a step of twelve inches all around the pier. If known we can find a good natural foundation at not too great a depth, we often use the above method, leaving out the piles and placing the mat directly on the natural foundation. This method we use only in the shallow water.

In deeper water we use a coffer dam. Piling is sometimes used but more often we depend upon a natural foundation. The sides of the coffer dam should have a batter of 1-2 inch to the foot, allowing the cofter dam to release itself as the ground within is excavated, or when "ditching" as digging away from the sides is termed. Again the water is kept out by means of centrifugal pumps using a 6-inch, 8-inch, or 10-inch pump as the case may require.

By this means we excavate to the natural foundation, and then put in a mat of concrete about 3 feet deep, well tamped. This we allow to stand 48 hours, when the water is pumped out for the last time and the balance of the concrete put in in the usual manner. All our concrete is mixed by machine and conveyed to pier, either by steam crane and bucket, or by wheelbarrow. This method of construction can only be used where pumps can control the water.

Plate 2, Figs. 1 and 2, show the general construction of coffer dam used. In the case shown, the depth was slight and 6 x 6 timbers were used. Ordinarily we make the framework of 12 x 12 or even heavier; the outside covered with two thicknesses of 2-inch plank surfaced on one side and edges. The joints of one row coming opposite the centers of plank on the other row, we obtain a very compact and almost water-tight coffer dam. The cutting edge is formed by beveling the ends of the plank as shown in Fig. 1. Fig. 1, Plate 2, also shows the method we adopt for making our forms.

We had a very difficult piece of work which has just been completed at the Oakland Terminal Depot. A short description of it may not be amiss at this time.

We have at the entrance to the Ferry Slip two large water tanks on each side of the slip. The tanks are placed one over the other in towers, which form architectural features of the Terminal Depot. These tank towers were originally on pile foundations with rubble filled in around the piles to water surface, about average high tide. This made the depth of rock about 12 feet. After a few years it was found that the teredos were cutting the piles, in spite of the protection the rocks were supposed to have afforded. We then took out the rock, levelling them down to low water and put a mat of concrete around the piles and resting on the loose rocks. This lasted a number of years, when it was found that the teredos had cut the piles entirely off, and the tanks, concrete, and loose rock were gradually moving into the slip. Something had to be done, and it

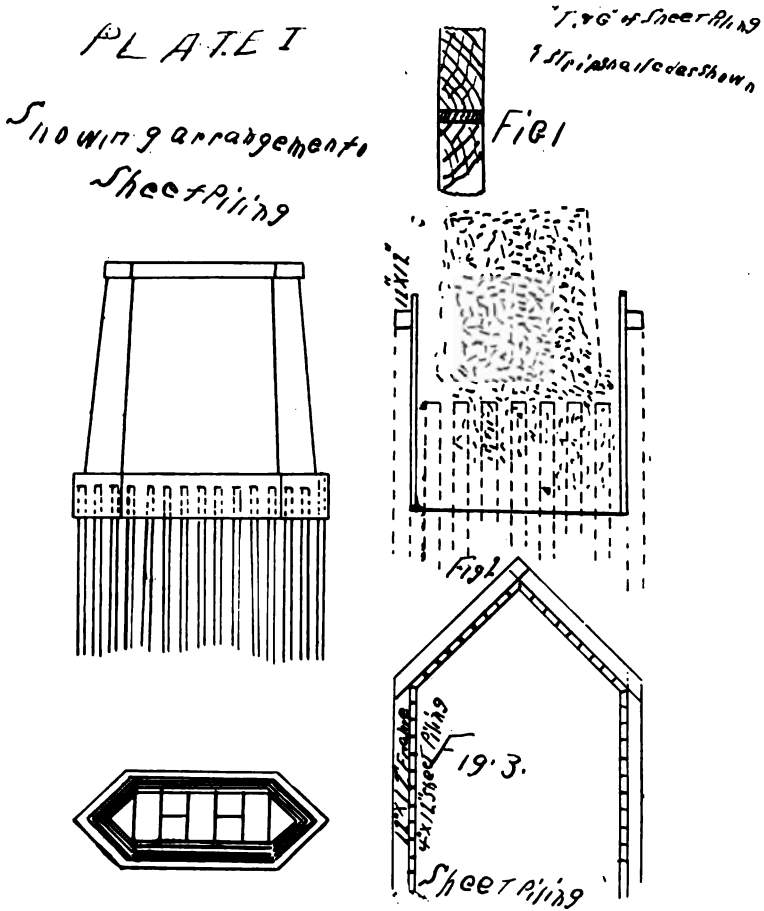


FIG. 8.—Showing Arrangement of Sheet Piling.

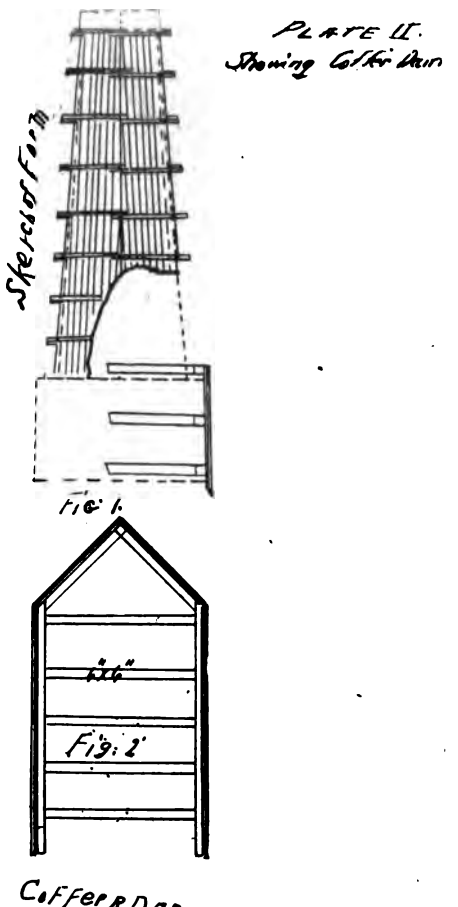


FIG. 9.—Sketch of Form of Coffer Dam.

was decided to sink a cylinder at each corner of the towers, to hard pan 20 feet below low water. At first a wooden cylinder was tried.. This was 24 feet long, 6 feet, 6 inches diameter at the bottom, and 6 feet 0 inches diameter on top. In spite of the many bands on the outside, it was impossible to keep the cylinder air tight when part of it was in water and part out. This had to be abandoned and was replaced by steel cylinders. The steel cylinders were made in 7-foot sections out of 1-4 x 84-x 120-inch sheets of steel. The longitudinal joints were lapped with a 1 3-4-inch lap and riveted with a single row of 1-2-inch rivets spaced 1 3-4 inches apart. The inside bracing was composed of rows of 1-2 x 3 x 3-inch angles riveted to the sides and spaced at varying distances according as to the depth at which section was to be used. Spacing in lower section was 24 inches apart and in top section just one inch around the middle. At the horizontal joints the angles were put on the outside and the joints made with screw bolts and lead.

The air lock was a section of boiler closed top and bottom, made exact size of sections of cylinders, with angle iron on bottom so an exact joint could be made with each section. In the side and bottom was a manhole covered by a hood, that when closed was perfectly airtight. The manhole in the side was about the middle of air lock, the one in bottom was as close to one side as possible. On the opposite side and about half way up was a shelf upon which the mud and rocks were placed as sent up from below. When this shelf was full, the men would come up, close manhole in floor, and three loud raps on the side would cause the air to be turned off and the hood at the side lifted when the mud, etc., would be discharged. The lower portion was lighted by 5-16 candle-power incandescent electric lamps and the lock was lighted by 3-16 candle-power lights. For a guide for the cylinders a square frame was used, open at two sides, so the sections could be put in. It stood 24 feet above the wharf and was supplied with a pully in the top with which to handle the sections.

When air lock was in place two 1 1-4 chains with turn buckles at each end were taken over the top and fastened at ends. When air was out of caisson the turn buckles were screwed up and the cylinder was forced down. On one of the cylinders the angle iron on outside at horizontal joint got caught on the old cement mat under water. This caused some delay, but was overcome by use of a 12 x 14-inch by 30-foot stick placed over top of air lock and used as a lever with leverage of 24 feet. By use of blocks and tackles on this lever the cylinder was forced down.

The compressed air was furnished from the main of the interlocking system on the pier, into a tank 6 feet 10 inches long and 3 feet 7 inches in diameter. The maximum pressure in this tank was 75 lbs., the minimum was 15 lbs. The maximum working pressure in the caissons was 15 lbs., the minimum 5 lbs. When the caisson was entered, a greater pressure than

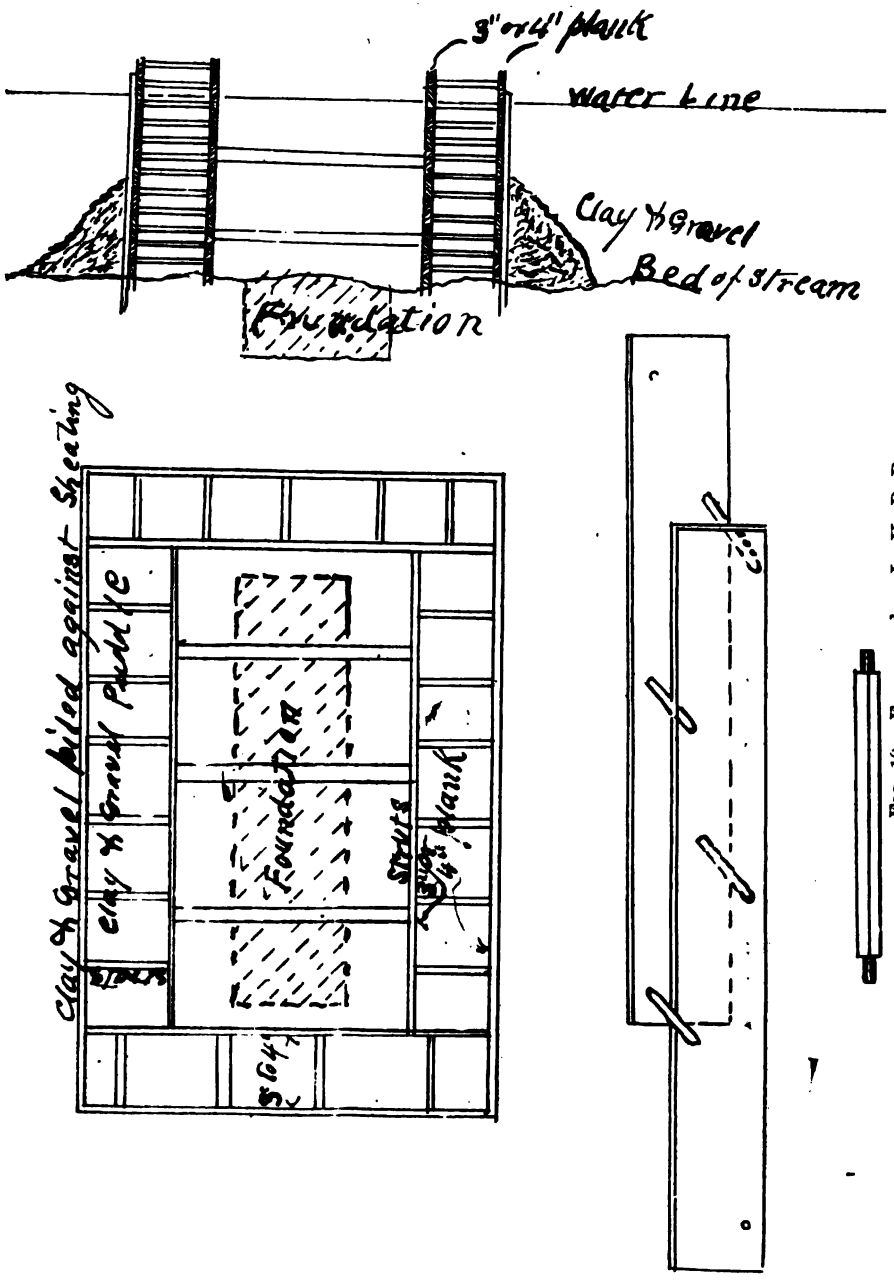


FIG. 10.—Form used on L. V. R. R.

the maximum was used, to force water out quickly, but was soon reduced to working pressure needed.

The light was furnished by a 60 light Gramm dynamo, run by a 3 1-2 H. P. gasoline engine. "The Otto." A telephone was placed inside the caissons so that communication could be had at all times without stopping the work. The work was kept up night and day. In all, eight cylinders were put down to an average depth of 20 feet below low water. This work took 8 weeks. The best record made was 3 feet in 24 hours, while the least that was made was when they were stuck on the concrete. The work was done when laborers were hard to get as there was so much work above on dry land that it was difficult getting men to go under water. Considering the awkward place in which the work had to be done, the result was satisfactory.

Mr. Berg.—I enclose a sketch made by one of my assistants, of a foundation method we have had used by two of our contractors during the last two years at half a dozen foundations in water up to 10 feet deep. It consists of setting up plank edgeways, held apart by oak rungs, forming ladders. It is a very cheap and efficient method up to 10 feet.

For depth from 10 to 20 feet, I believe, the method of a solid crib of 6 x 12, 8 x 12, or 12 x 12 timbers, resting on top of each other, caulked and iron dowelled together, is the best. According to whether the bottom dredging is done before or after sinking. If done before, then a hole or ditch is dredged out and the coffer dam sunk to bottom. Then any silt remaining is taken out by an orange-peel bucket and the bottom concreted under water ten or twelve feet up and the balance pumped out and work prosecuted in the dry.

If dredging is not done ahead, then the coffer dam is sunk and the interior dredged out by orange-peel bucket and the crib allowed to follow until home.

The subject of your report, while specifying 20 feet as the limit, I should say is intended to cover slack depths more particularly and for such I think the upright plank ladder coffer dam is very cheap.

Mr. Noon.—"I have had very little experience in putting down foundations to a depth of 20 feet. What work I have done in that line I have used the coffer dam. Consider it as good as any I have seen."

Mr. Markley (A. S.).—"Replying to your letter of July 26, in reference to putting in coffer dam for foundation in water having a depth of 20 feet and under. I know of no better way than the old style coffer dam made out of 2x8 sheet piling, 2 or 3 ply wherever the occasion demands it. I have used also the Wakefield Triple Lap Sheet Piling, which is the best wall for coffer dams I know of, made 3 ply, 2x8, and can be made abso-

lutely water tight. This sheet piling is made with tongue and groove and put together similar to flooring, the groove being 1 inch deep, the tongue, of course, being of corresponding depth. We have had very bad leaks where this piling was used and by simply running sand and gravel down the joint where the leak occurred would stop it at once. Where there is very much difficulty in keeping the earth and water out, this style of coffer dam is by far better than any I know of.

"I have had men explain to me that the putting in of mixed concrete in sacks dry and laying them in bottom of dam, in place of wet concrete forming a foundation for the structure, these are laid when the dam is filled with water, which of course you know is quite an advantage over the old way, because the water is not running over the mixture and washing the sand and cement away. I have had no experience in the last named mode, consequently I can only give it to you as others have given it to me, which from their report has been very successful."

Mr. Snow.—"Answering yours of the 25th inst. I don't know any better way to 'keep out water during excavation and construction of masonry' than the old fashioned coffer dam. Many piers are put in, however, without keeping out the water. You have, of course, read up on the method of founding on cribs. I can give you references, if you wish, to many articles in *Engineering News* describing the building of piers in Western rivers on cribs. I have had no experience, I am glad to say, in building masonry with the lower courses wood and the upper stone. Neither have I had experience in building masonry in tubs with detachable sides.

"I send you in another cover a blue print which shows a style of founding piers that has been used by the city of Boston a great deal in the tidal streams around here. The method is as follows: The soft mud is dredged out to sand bottom, piles are driven 3 to 3½ inches apart, then cut off to an approximate grade with a circular saw under water, then another set of piles is driven intermediate between the first ones and cut off at a higher level, then a line of 6-inch Southern pine sheeting grooved and splined is carefully driven around the cluster, with tops above high tide, then rich Portland cement concrete is deposited by means of a tube or 'tremie' among the piles till a sufficient mass is in place to resist the upward lift of the water when the water is pumped out and masonry laid in the usual way. The print which I send shows the second crop of piles altogether too high. in my opinion, and I believe the city engineers in their later practice have cut the two series as near one level as possible. The only valid reason for driving two sets is that more room is obtained between the piles for handling the saw frame. A better scheme, in my opinion, is to use a steam piston hammer driver with a large pipe follower and put the

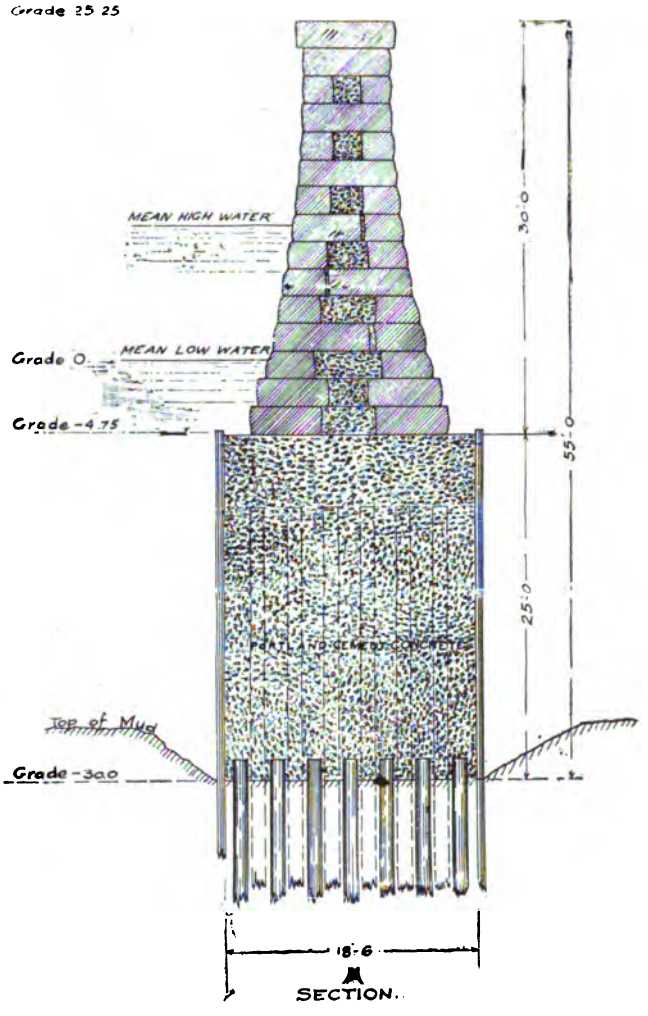
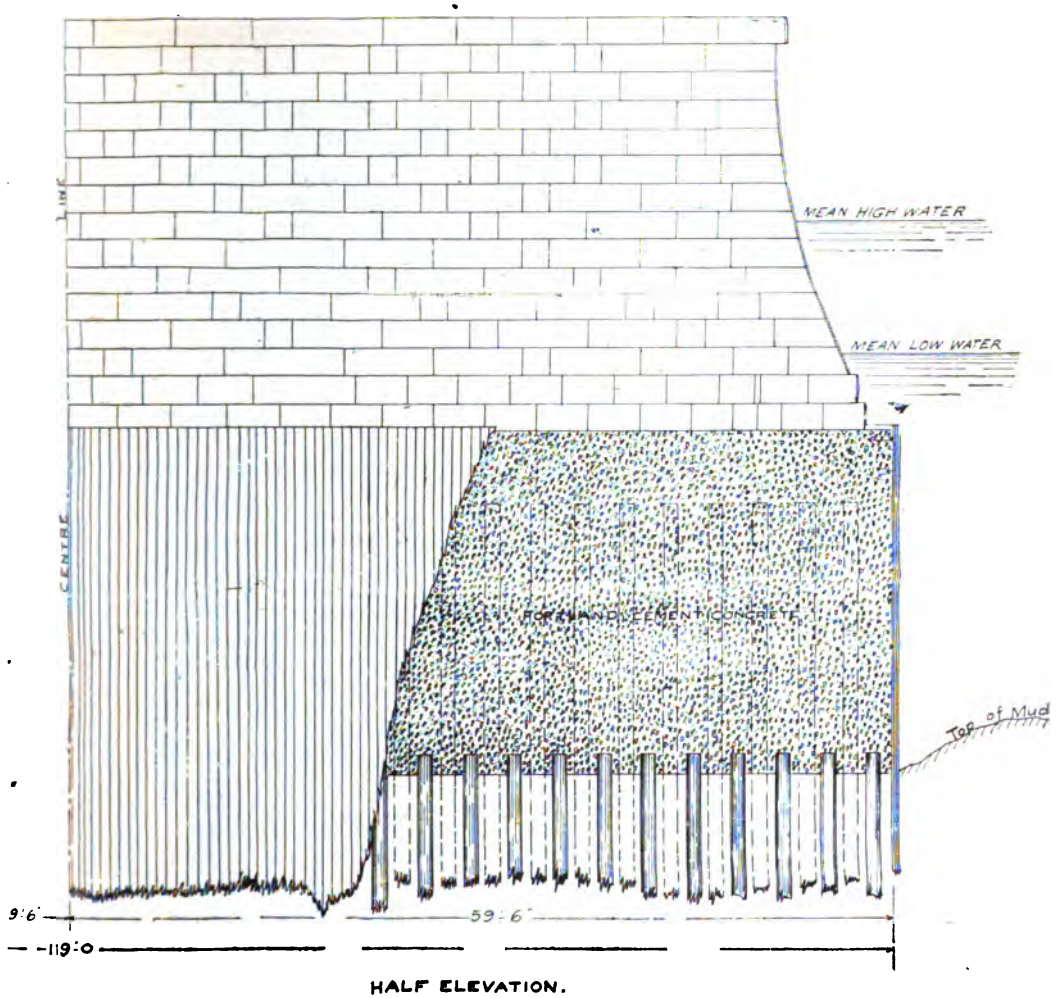
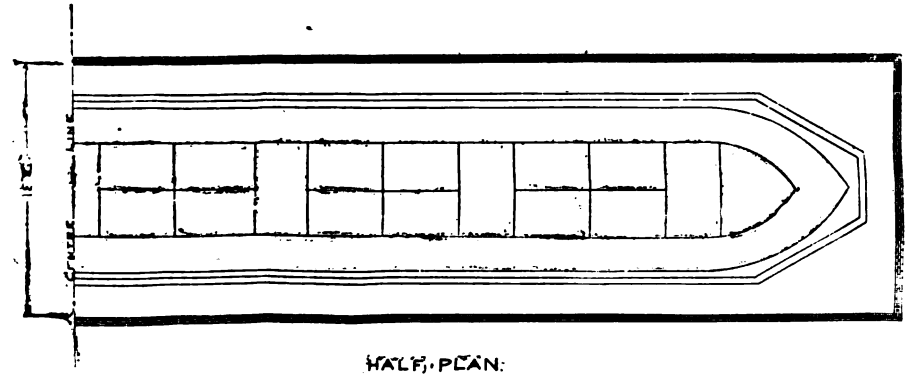


FIG. 11.—Charlestown, Mass., Bridge, Pier No. 5.



HALF ELEVATION.



HALF PLAN.

FIG. 12.—Charlestown, Mass., Bridge, Pier No. 5.

pile right down to grade so as to need no cutting off. It is immaterial, of course, about having the heads all at one exact level. I would advise having their heads only a foot or two above the bottom of dredging as it is next to impossible to get good results with the concrete tube working among the pile heads. If proper brands of Portland cement are used there is no trouble at all in getting excellent concrete when put in in this way. If you would like to read more about this subject I will try to get you the annual report describing the bridge of which the pier shown on the print that I send forms a part. The water here is 30 feet deep, which I guess is about as deep as this method has been used.

"Of course if piles are not needed the case is simplified. The sheeting is driven only enough to hold the toes. It is cut off at low water when the pumping is finished.

"When it is desired to pump out and excavate in the open I favor two lines of planking about ⅔ of the depth apart filled with gravelly earth. If a single line is tried it must be driven very nicely or there will be trouble, and unless the ground is perfectly clear it costs more to get a single dam tight than it does to drive and fill a double one. If a double dam is used it needs to be driven only tight enough to hold gravel and the filling will do the rest. Moreover it may be made of cheaper stock. I do not believe in the old fashioned English rule of using clay for filling coffer dams. The material should be pliable enough to crumble down if the least hole is washed out of it, and it should be heavy enough to settle at once in water.

"It pays to set a coffer dam well out from the limits of the excavation so that the natural bed of the stream need not be disturbed next to the sheeting, and if much earth must be excavated a generous sized dam allows of setting an inner line of sheeting to follow down with the excavation.

DISCUSSION.

Mr. Stannard.—Our method of sinking foundation in water six feet and over in depth; will say, we drive sheet piling two thicknesses and filling in around piling to keep water out. Where we can obtain rock at a reasonable depth we excavate to the rock, leveling up with concrete, upon which masonry is started In case we do not find rock we then drive piling to a sufficient depth to secure a good foundation, cutting piling off to a level, excavating around piling to a depth of about three feet and fill this space with concrete level with top of piling, starting masonry on top of piling, being particular to use large footing stone for the two bottom courses. The concrete should extend at least sixteen inches outside of piling line which binds and protects the entire foundation.

I also find it works well to drop concrete a distance of fifteen to twenty feet, having concrete thoroughly mixed before dumping. This process is intended for any soft foundation.

Mr. Cummin.—Do I understand, Mr. Stannard, that you come just up to a level of the top of the piling and start your masonry on that, using a large footing stone for the first course?

Mr. Stannard.—Yes, sir.

Mr. Cummin.—My idea is not to stop at the top of the piling, but to go several feet above them, and I find that gives very good satisfaction.

Mr. Stannard.—Our experience of bringing concrete level to the top of the piling and starting the masonry on top of that, is that we have had good results from every case. The old way used to be to bring it up to the top and then plank it over and start the masonry; found that not as good as starting on the concrete.

Mr. Cummin.—It seems to me that you would get better results and less chance of settlement by going above the piling than you would by stopping at your piles and starting your masonry on them. If you carry your concrete above your piles and start your masonry, you are on a solid mass of concrete and no chance for settlement, and you are going to have a permanent job of it.

President.—I would like to ask Mr. Stannard what value the concrete is if stopped where the piles are cut off?

Mr. Stannard.—You depend on your piling for your support, that is the main thing. If you don't depend on them, it would not be necessary to put them in. They are the main support of the pier or abutment where you are in soft ground.

Mr. Markley (A. S.).—We have not had occasion to build a coffer dam in that depth of water for a number of years. Some eight or ten years ago, at Momence, Illinois, we had a solid rock foundation in four feet of water, but we found it almost impossible to keep the water out, and we wanted to lay stone, and we used triple lap sheet piling manufactured by a firm in Chicago, and in using that we had no trouble with it. I do not quite agree with Mr. Stannard in his mode of pile foundations. Where we have been putting in pile foundations to start masonry on, we run the concrete some two or three feet above the top of the piling, of course ramming the concrete thoroughly between the piling, and carry the masonry either of stone or concrete from that on up. There is

very little support on the concrete if brought just to the top of the piling, and I think there would be some settlement that cannot be overcome in the concrete.

Mr. Stannard.—In putting foundation down where it is soft, you do not depend on your concrete; the piling is the main support, and you put your stone on top of the piling, and there is no chance for settlement.

Mr. Markley (A. S).—I agree with Mr. Stannard in this direction. Still there is some support between the piling, but if you are going to depend on the piles alone for support, what is the use to put the concrete in?

Mr. Stannard.—No, it makes a big difference and binds the piling and makes a much better job of it.

Mr. Staten.—About three years ago I saw a coffer dam made on a solid rock bottom. They got two-bushel coffee sacks and filled them half full of dirt, and laid one on top of the other, and made a row clear around and pumped the water out with a tin pump and started the stone work. The sacks were about half full of clay, placed one on top of another on a solid rock bottom, and pumped it out, and it held better than any cofferdam I ever saw.

Mr. Cleaveland.—I am having a little experience in the coffer dam business at the present time, building a steel viaduct and foundations through a low bottom where there is quicksand, and we used a double sheath piling coffer dam. The inside row of sheath piling was eighteen inches outside of the piling that we drove for foundations. The second row about two feet outside of first row; then we packed between those two rows of sheath piling with clay and rammed it in, and have not experienced any difficulty yet in keeping those pumped out dry, and the water is about six feet deep. I built a coffer dam not long ago in the centre of a stream where the water was nine feet deep, and the bottom of the stream was rock, and the worst kind of rock, honeycombed rock. We made the same kind of a coffer dam there, and drove the sheath piling down until we struck rock, got a lot of horse manure and put that in first, then put clay on top of that and rammed it and pumped the water out, and when we found leaks we stopped them up by driving inch boards on the outside of the second row of sheath piling.

Mr. Eggleston.—We are putting a pier in a river now where

we had some trouble once before when we put abutments in. This time we put our dam in six feet of water, drove the sheathing, pumped it out without any difficulty and sunk the excavation six feet below the bed of the stream. From the top of the water to the bottom of the pier is twelve feet. We got along very nicely. What I desire to bring out here, if I can, is the best method of putting pier in where you have got quicksand or any kind of bad ground and got to go twenty feet below water.

President.—Why do n't you drive as many piles as are necessary to carry the load, cut them off under water with a saw made for that purpose at about the bottom of the river and sink a caisson on top of the piling; and rip-rap around the outside?

Mr. Eggleston.—The surface of the ground is right at the top of the water. You have got to commence your excavation and go down twenty feet or more. There is no margin to go on.

Mr. Killam.—Would say in reference to those foundations, on our road, the Intercolonial, there are very few foundations of concrete, in fact none put in when the road was built, but two years ago we experienced some trouble with a pier at one of our bridges, a bridge consisting of two one-hundred foot spans; the pier was put down nine feet below low water, on hard pan, and considered to be good bottom, but in the course of time, the soil bank above the bridge washed away and threw the stream crosswise on the side of the centre pier and undermined it. We got a diver and sent down to investigate, and found where a large space had been washed out from under one side of the pier nearly through to the other side. And to remedy the trouble, we made concrete; making it, I think, four to one, pretty strong, and put it in bags and the divers went down and filled up the space with them, filling the bags about half to two thirds full, putting the smaller bags further in under the pier, until the space was entirely filled up, and it is now apparently as solid as any pier on the road. Strange to say only one small stone fell out of the bottom of the pier. It had been so well built that the masonry held together though nothing was under it to hold it up on the side undermined.

Mr. Markley (A. S.).—Answering Mr. Eggleston, if I was doing that job, I should sink sheet piling two inches by eight inches and start it about two feet larger than the dimensions of the pier, and then put in a second line inside of that, and continue on down to

the required depth with the inside sheet piles, provided outside ones could not be driven farther.

Mr. Sheldon.—We have found where it is necessary to use a coffer dam that we get much better results by using double coffer dams. We have tried it with a single coffer dam, but found it almost impossible to pump it all out, and by putting another coffer dam around it, and filling between, then we have pumped it out without any difficulty.

President. — With reference to Mr. Sheldon's statement in which he claims two rows of sheet piling are best, it seems to me that it depends largely on the local condition. Take a case where the water is six or seven feet deep, very little current and perhaps clay bottom, the single row in my experience has worked very satisfactorily. You simply pack outside of the coffer dam with clay, the current not being strong enough to wash the clay away. Then take a case where the water is perhaps deeper, with gravel bottom or a sand bottom, my experience has been that the double row is the most satisfactory. The width between the two rows being determined by the depth of the water to be contended with, and by the material encountered in the bottom.

About three years ago we put in a bridge across a slough in the Mississippi river in Iowa; the material was very soft and the water about seventeen feet deep. As I recollect it, our method at this place was to drive sufficient piles to support the pier. We then surrounded the piles with Wakefield sheet piling, built cofferdam as tight as we could with the Wakefield sheeting, and then instead of attempting to pump the water out, we simply filled in with concrete without cutting the piles off, up to within about five feet below low water, allowed the concrete to set, then pumped the water out, cut our piles off and completed the pier. It worked very satisfactorily and in that case seemed to be the thing to do. Then about a year ago last July we started the foundations for a new bridge across the Mississippi river between Minneapolis and St. Paul. The old bridge was a cantilever bridge with low stone piers about twenty-five feet above low water, with iron bents supporting the spans. The base of rail on the bridge was about one hundred and fifty feet above low water. The new piers were placed twenty-seven feet centers from the old. The material in the bottom of the river was coarse gravel, overlaying a

very soft sand rock. The water ranged from eight to twelve feet deep. The old piers rested on grillage at a distance of about eight or nine feet below low water. The method followed was to use the old pier for one side of our coffer dam, filling in with clay on its far side. On the other three sides of the new pier we drove first two rows of round piles for guide piles, then one row of Wakefield sheet piling on the inside, composed of three pieces of four by twelve, and for the outside row we used plain eight by twelves. As I remember it, we drove the two rows about ten feet apart. Between the two rows of sheet piling we filled with clay up to about low water, and above that filled with any material that we could conveniently get. The two rows were fastened together with rods. By the way, I should say the conditions were such that there was no chance to brace across the pit. We had to make the coffer dam self-supporting, and it might be well to say that was why we used such a wide distance between the rows of sheet piling. We then pumped out the pits very satisfactorily. Some trouble occurred with leaks where the sheet piling came down on the rock. We went four or five feet below the old piers along side of them, and placed the concrete foundations.

Mr. Fletcher.—I have had very little experience with foundations as my business is mostly on superstructure, but I had one case where I put in foundations a short time ago in north Michigan, where I had a very coarse gravel bottom mixed with large boulders. In putting in coffer dam I drove two rows of sheeting five feet apart and filled in with clay. When we got the coffer dam as well prepared as we could, and commenced to pump it out, we found that the water was coming up through the foundation, in fact all over the foundation. We went at it again and did everything inside and outside the coffer dam that we possibly could to shut out the water, but about failed. Finally we lowered the water enough to dig down enough to get timber below low water line, and drove pile and put on grillage.

We had a large marine pump throwing a sixteen-inch stream, also one throwing an eight-inch stream. Still we had very little control of the water. We finally, however, with the two pumps and several hand pumps got the water down so that we could cut the piling off, fill in with concrete, and place the grillage. We had great trouble in driving piling on account of the boulders,

some would break and some would sheer off crooked. We used hard piling and found it necessary to nearly double the amount required if they had all been good. I think, however, we got a good foundation; they have been in use about two years with no signs of settling.

It was the original intention to build on the bottom without piling but found it impossible to get down to it.

Mr. McNab.—Would like to ask if any of the members have had any experience in jetting down sheath piling.

President.—I have jetted ordinary piles.

Mr. McNab.—I mean sheath piling.

Mr. Cummin.—In jetting down sheath piling, I simply jet them down the same as I would round pile, and I also use a double jet for round piles for the reason that I think you can get your pile down straighter and do it a great deal quicker than with a single jet. That is, just use a double instead of a single jet.

II.—Passenger Platforms at Way Stations, Best Material and Cost of Same.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee of this subject beg to submit the following report:

Believing that the practical knowledge and experience of those who build and care for platforms would be the best source of information, a circular letter was sent out to the members asking them to state the various kinds of platforms in use on their roads, giving the method of construction, kind of material, cost of platform and average life of the same with their opinion as to results obtained. Replies were received from twenty-one members representing sixteen different roads.

The replies received were from all sections of the country and probably include all kinds of platforms in general use in the United States. Thinking that the members were familiar with the matter of building platforms we have tried to give what we thought would be most valuable to them, viz.: The cost of platforms, the length of time they will last, and the satisfaction they give in service. From the replies received we find that there is a great difference in the cost of labor and material in the different sections of the country. The price of lumber runs from $9 to $30 per thousand, with the cost of labor from $1 to $3

per day. With this variation of prices the cost of a certain kind of platform in one section might be thought too high, or low, in some other section. Having this in mind in our report, we have given the average cost of each different kind of platform, with the average life and the results obtained from its use. All of the roads report the use of wood platforms costing from six cents to fourteen cents per square foot, the average being ten cents per square foot, and the average life ten years.

Three roads report the use of brick platforms costing from ten to twenty-five cents per square foot, with an average cost of thirteen cents per square foot.

The use of coal tar concrete was reported by four members on two different roads, and cost from three and one half cents to fourteen cents per square foot, with an average cost of seven and one half cents per square foot, and an average life of thirteen years.

Three roads use cement concrete platforms at an average cost of fourteen cents per square foot.

Nine roads use cinder platforms at a cost of three cents per square foot.

Five roads use crushed stone platform. No data as to its cost.

It would seem to this committee that for local stations there would be different kinds of platform needed to serve the different kinds of business. At stations where only light baggage was handled and a small number of passengers, the use of cinders, crushed stone, or gravel might meet all demands. At stations where baggage and express matter are handled in considerable quantities some kind of platform over which heavily loaded trucks can be easily drawn should be provided.

Several members criticised the use of cinders and crushed stone, as it is tracked into the coaches and stations, cutting out the floors and making more work to keep them clean. Against this is the less cost of this kind of platform.

If cinders are used a suitable curb should be provided to keep them away from the rail. Cases have come under the observation of your committee where cinder platforms have been put down, filling level with the top of and against the side of rail, where in a few years the rails and spikes were so badly rusted by the sulphur and acid in the cinders that the track was unsafe for use. Where cinders are carefully rolled and made compact they make a dry platform suitable for light business and at a low cost.

Platforms where trucks are much used should have a hard, smooth surface. For this class of platforms, wood, brick, cement, and coal tar concrete can be used, and the kind giving the best results as to cost, desirability, and safety would be cheapest.

The average cost of wood platforms we find to be ten cents

per square foot, and they last ten years,—making the cost of a wood platform one cent per square foot per year.

Brick platforms cost thirteen cents per foot, with no data as to average life. Assuming this to be twelve years (which was named by one member) the annual cost would be a little over one cent per square foot.

The average cost of cement concrete platforms is given as fourteen cents per foot and the durability unknown.

The average cost of coal tar concrete is seven and one half cents per foot and average life thirteen years, making the cost per year six tenths of one cent per square foot. The cost of coal tar concrete as seen from the figures given is 40 per cent. less than either brick or wood. But where this is used some kind of a curbing should be provided. Wood curbing is the cheapest but will not last. Stone curbing costs about 65 cents per lineal foot in position. Cement concrete curb costs 28 cents per foot and should be durable, although your committee could get no information as to its actual life.

Taking ten feet as the average width of platform we find that with granite curb the cost of tar concrete platform is the same as brick. With a curbing of cement concrete the cost is 20 per cent. less than either brick or wood.

The members using tar concrete platforms report it as very satisfactory, being hard, smooth, and less slippery than any other kind except brick. Its use, however, seems to be confined to a small section of the country; and, so far as we could learn, little was known about it outside of this section. Believing it to be one of the best, cheapest, and most economical kinds of material for railway platforms, we will try and give the usual manner of putting it down. First, level the ground, making it about four inches below the desired level of the finished platform. Cover this with a layer four inches thick of broken stone or very coarse gravel, or pebbles, from three fourths to three inches in diameter which have been well covered with tar. Roll this down with a stone roller weighing not less than 600 lbs., which has been smeared with crude oil to keep the tar from sticking to the roller. On this bed spread a layer of top dressing prepared in the following manner: Take clean, hard sand, such as would be used for good cement, heat this to about 250 degrees and until its moisture has been expelled. Add to this a mixture of three parts of good coal tar and one part coal tar pitch which has been heated until it boils. Stir the sand and coal tar mixture together. When both are hot, spread evenly on the prepared stones about two inches thick. Sprinkle over this fine sand or mica and roll to a hard, smooth surface while it is hot. Tar of good quality with a heavy body should be used. Care should be taken in heating the sand so that it will not be burned. If it does the concrete will be much injured. When carefully prepared and put down we

have seen platforms which have had severe and continuous usage for more than fifteen years and are in good condition yet.

J. B. SHELDON,
JOHN T. BANKS,
N. H. LAFONTAIN.
L. H. WHEATON,
WM. A. FORT,
A. MCNAB,
Committee.

DISCUSSION.

Mr. Sheldon.—The average cost of wood platforms appears to be ten cents per square foot, making one cent per square foot per year, and I think this a conservative estimate; brick platforms, thirteen cents per foot, and your committee, in preparing data as to the average cost of platforms, found one member who said that a brick platform was good for twelve years. Assuming twelve years as the life of same, the cost of a brick platform would be a little above one cent per square foot per year. Cement is given at fourteen cents, but, as to durability, unknown how long it will last. Then coal tar concrete platforms are used by a few roads, and it appears the cost is seven and a half cents per square foot, and I think the life given was thirteen years, making the cost six tenths of one cent a foot per year, but think there should be a curbing of some kind used. I have used cement concrete for curbing. We used a little last year, and used more of it this year. It costs from about twenty to twenty-five cents per lineal foot in position. With the use of that, it would bring the cost of the coal tar platform up to about two thirds of the cost of the wood platform. The use of cinders and crushed stone was objected to by a good many of the members, as it is hard work to draw a loaded truck over it, and I think quite a few objected to the use of it, as they said it cut out the floors of the stations and the coaches and kept them looking badly, and also made it cost more for renewals. Reports from those using it show that the coal tar concrete platform, properly put down, was the most economical platform that was in general use. I will say personally that I have been familiar with it for a number of years, and like it very much. The wood platform is all gone in ten years, and requires more or less attention

after four or five years and it would seem that for way stations the coal tar platform would be the best to use. Another thing in its favor is, it is never slippery unless actually covered with ice, while granitoid and asphalt platforms are very slippery in wet weather, which seems to me to be a serious objection to a platform. Under no conditions have I ever seen a coal tar platform slippery unless actually covered with ice.

Mr. Berg.—I would like to ask Mr. Sheldon for some information in regard to the coal tar platform, as to what roads reported using it, and then I am interested in the description of the top dressing,—I mean the proportion of the sand to the composition. The composition as described calls for three parts of good coal tar and one part coal tar pitch and mix that with sand, but it does not say what proportion.

Mr. Sheldon.—The proportion varies somewhat, depending partly on the weather (whether in cold or warm weather), and partly on the sand used. In ordinary summer weather the proportion should be approximately 60 gallons of tar mixture to one cubic yard of sand. In cold weather 20 to 30 per cent. more clear tar can be used, and the concrete will be improved in quality and lessened in cost.

Mr. Berg.—I would like to ask Mr. Sheldon whether there is anything in the local market conditions of coal tar that makes the cost so low.

Mr. Sheldon.—I would say that the lowest cost reported was forty cents per yard, by Mr. Austin, by contract. The highest cost reported was by Mr. Pickering, $1.25 per yard. The average cost around the city of Boston and Providence is about fifty cents per square yard—depends some upon the locations. We have always put it down so far by contract, at from forty to fifty-five cents per yard, the contractor agreeing to furnish all the material after the bed has been prepared.

President.—The secretary has a written discussion from Mr. J. P. Snow with reference to this subject, which Mr. Pickering will please read.

Mr. J. P. Snow, Boston & Maine R. R. (by letter).—With us the cost of these platforms is from six to seven cents per square foot. Our specification is as follows: "The platform will be paved with coal tar concrete. It shall be at least four inches

after being thoroughly rolled, and must be put down in the best manner. The ground shall be prepared by the contractor and well compacted before the concrete material is put on. The first or lower course of stone to be not less than one inch in diameter and the second course not more than one inch, both these courses to be well covered with tar before laying, and thoroughly rolled. The finishing course to be not less than ¾ inch in thickness after it is rolled, and to be composed of good, clean, sharp gravel, well dried, heated hot, and mixed with half pitch and half tar. This course to be well rolled and all edges well tamped and smoothed with proper tools. The roller prescribed above to weigh not less than 700 lbs. on a length of not more than 22 inches. Curbstone will be required on the track side only. On other sides the concrete will be rolled down and stopped in the ground. A curb must be used on the side next the rail. It is not necessary on other sides unless at stations where many teams back up to the platform. Our rule is to set the face of the curb 2 feet 6 inches from outside of rail head, with the top level with top of rail, and in country stations to finish the ends and back side with a depressed edge without a curb. Barring the curb, tar platforms cost rather less than those of 2-inch plank, and their maintenance is very much less. Old-fashioned gas tar should be used. Tar from retorts where water gas is made is useless, and many of the quick-process, gas-making ovens produce very poor tar."

Mr. Markley (A. S.).—I would like to ask Mr. Sheldon whether he makes his concrete curbing on the ground or at his shops. We are making our concrete curbing, using Universal Portland cement, and get it out for ten cents per running foot. We make it in our yard at Danville, Ill., using cheap laborers at about a dollar and a half a day.

Mr. Rettinghouse.—We have a platform that we have been making in the line of an experiment; it is a concrete made of locomotive cinders and Milwaukee cement, proportion of one part cement, one part sand, and six parts cinders. We make it a thickness of six inches. We propose to use either stone curbing or concrete curbing if we find this is a success. Up to the present time it has given very good satisfaction. I have some figures here of what the work so far has cost us. The first platform I built at New London Junction, 375 feet long and with an area 5,120 square feet.

The average cost for this platform, including filling, was eight and nine-tenths cents per foot; the concrete proper, of which there was 3,600 square feet used in this, was three and three-tenths cents per square foot. The next job to this was a large platform, with nearly as much filling as the first; the total cost of this platform was only five and seven-tenths cents per square foot, while the concrete proper was two and twenty-six hundredths cents per square foot. We have built a number of cinder platforms without using concrete, and, summing up, I have built about fifteen or sixteen in a season. They are used in such cases where there is not very heavy traffic, mostly such stations where there is no station building, and the average cost of that kind of a platform we have brought down to three cents per square foot complete. The cinder platforms for that kind of a station give very good satisfaction. We tamp them, and use in all cases the coarsest kind of cinders or clinkers.

President.—How much would it cost, Mr. Rettinghouse, to use Portland cement, say one part cement, three of sand, and the requisite part of cinders?

Mr. Rettinghouse.—I dare say it would not increase the cost more than one cent per square foot.

President.—The difference would be warranted in the assurance that the Portland cement platform would be so much better than the natural cement.

Mr. Rettinghouse.—I am rather inclined to favor the Milwaukee cement, because I think it a very good cement, and because it only costs about one third as much as the cheapest Portland cement you can buy.

Mr. Berg.—I wish to say that the discussion is very important, as illustrating the mistake railroads have been making heretofore of using lumber promiscuously, and the fact that it is necessary in many cases to find a substitute for lumber. This summer we had occasion on the Lehigh Valley Railroad to build a freight house with 80,000 square feet of flooring, to replace one burned down. The old floor was 3-inch planking on mud sills. We figured on timber, and the cheapest cost was 13½ cents per square foot, using Norway pine, and then we got a bid for cinder concrete with expanded metal furnished in place at 15 cents. The cost there of a first-class concrete floor was, therefore, only 1½

cents more per square foot. This floor is four inches thick. First there is a cinder bed, and then the floor itself is four inches thick, made of 3½ inches for the cinder concrete in proportion to one Portland cement, two sand, four cinders; and top dressing ¾-inch, Portland cement one, sand two. We believe that this floor will stand all the trucking that has to be done over it, and it simply emphasizes the fact that for the same, or very nearly the same, cost you can get a good permanent platform in the place of the wholesale use of timber. This class of concrete can be used extensively for platforms at way stations, and is cheaper than the old-style concrete. For smaller way stations crushed stone is frequently used, especially at little way stations, where there is not so much objection to tracking the dirt into the station. I believe great economy can be effected in the abandoning of the wholesale use of wooden platforms indiscriminately.

Mr. Large.—The great trouble about the screenings is, just as soon as it begins to freeze and thaw and gets a little damp, they pick right up, and soon the platform becomes very rough and you get nearly as many of the screenings in the house in a short time as you have out on the platform, and we abandoned the use of them entirely.

Mr. Bell.—On the question of platforms I have no experience to give with concrete, either with the asphalt preparation or the substitute for same that I have heard discussed, but can give you something better than that, but I do n't know whether or not it will interest the Northern members; do n't think they have got the material. We use in Florida, for passenger stations where the traffic is not very heavy, carbonate of lime with flint lime rock. We put on the carbonate of lime over the flint rock with plenty of water and roll it to a smooth surface, and let it stand twenty-four to thirty-six hours without anything heavier than foot traffic over it. It makes a nice, smooth walk. The only objection is from being placed at a point where it is under shelter we are bothered with dust to a small extent, but where exposed to the weather, never. It costs, finished, not over two cents per square foot. It is much cheaper than pine at $8, or cypress at $11 per thousand.

Mr. Markley (A. S.).—Some four or five years ago we used stone screenings for platforms, and our experience was practically the

same as that of Mr. Large, the passengers carrying them into the depots, also into the coaches. We are now putting down paving brick, made on our line, known as No. 2, size three inches by four inches by nine inches. We get them for seven dollars per thousand, and it makes a very good and substantial platform.

President.—Concrete base or sand base?

Mr. Markley (A. S.).—Sand base.

Mr. Cummin.—What do you use for curbing?

Mr. Markley (A. S.).—Concrete curbing.

President.—This brick platform, what does it cost per square foot?

Mr. Markley (A. S.).—Three cents per square foot for brick and two cents additional for labor laying. At small way stations we use cinders, and we find them much better than crushed stone, and we also use stringers for curbing.

Mr. Sheldon.—Some ten years ago I tried screenings on a bed of clay, sand, and gravel, and would say that our experience was similar to that of Mr. Large and Mr. Markley. They did not give good results and tracked badly, and hard and difficult to draw a truck over. Had better results with cinders than crushed stone.

Mr. Large.—Would like to know as to the height of the platform, whether the platforms are put on a level with the rail or elevated above the rail.

Mr. Markley (A. S.).—Eight inches above the rail.

IV.—Best Method of Operating Turn-tables by Power.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on the above subject submits the following report:

The operation of turn-tables by other than hand power has, up to within a few years, been unknown, except possibly in certain cases where steam was used. The question of obtaining suitable power to facilitate the turning of locomotives by some motive power was brought to the front by the decided increase in the weight of locomotives during the last few years. The weight of locomotives on some of the railroads to-day is such that they cannot be economically turned by hand, not only on account of requiring too many men to do the work, but the question of turning of locomotives at junctions and busy terminal points quickly is a vital factor in considering the question as to what power to adopt to turn locomotives and other rolling stock, both promptly and economically.

Your committee have addressed a schedule of questions on the subject in hand to all the members of the Association; forty-one members replied, and out of these only four have turn-tables equipped with power. The committee have also addressed a few parties not members of the Association, and have obtained some valuable information from them.

TABLE SHOWING INFORMATION FURNISHED BY THE MEMBERS OF THE ASSOCIATION USING POWER FOR OPERATING TURN-TABLES.

Name of Railroad.	Name of Member.	Kind of power.	No. of horse power.	Speed of turn-table at rim of pit, feet per minute.	No. of engines turned in 24 hours.	No. of men employed per day 24 hours.	Diameter of turn-table, feet.	Style of centre-bearing used.	Power is applied to table by.	Cost of operating turn-table by hand per 24 hours.	Cost of operating turn-table by power per 24 hours.
C., M. & St. P.....	G. W. Smith.....	Electric.....	10	200	200	2: 1 day, 1 night	56	Conical roller..	Overhead switch...	.....	½ cost by hand.
C. & N. W.....	C. A. Lichty.....	Electric.....	10	220	100	2: 1 day, 1 night	70	Conical roller..	Contact ring at centre...	.....	Less than ½ cost by hand.
C., Bur. & Quincy	Fred Ellers.....	Electric.....	10	300	200	2: 1 day, 1 night	60	Conical roller..	Overhead switch.....	$11.25	$4.69
Ill. Cent.....	O. J. Travis.....	Electric.....	7½	207	.....	2: 1 day, 1 night	66	Pivot bearing...	Contact ring at centre...	16.44	3.00
C. & N. W.....	A. Montzheimer	Electric.....	10	226	400	4: 2 day, 2 night	60	Conical roller..	Contact ring at centre...	13.40	4.95
L. V. R. R.....	F. E. Schall.....	Gasoline engine	5	200	144	2: 1 day, 1 night	65	Pivot.....	.....	7.50	3.60

TABLE SHOWING INFORMATION FURNISHED BY PARTIES NOT MEMBERS OF THE ASSOCIATION.

Name of Railroad.	Name of Member.	Kind of power.	No. of horse-power	Speed of turn-table at rim of pit, feet per minute.	No. of engines turned in 24 hours.	No. of men employed per day 24 hours.	Diameter of turn-table, feet.	Style of centre-bearing used.	Power is applied to table by.	Cost of operating turn-table by hand per 24 hours.	Cost of operating turn-table by power per 24 hours.
Pennsylvania....	W. W. Atterbury...	Electric	22	370	368	2: 1 day, 1 night	75	Conical roller.....	Contact ring at centre...	.....	$4.34
Pennsylvania.....	W. W. Atterbury...	Steam.....	....	280	.....	2: 1 day, 1 night	60	Conical roller.....	.....	.....	4.90
Erie.....	C. W. Buchholz.....	Electric	15	.....	140	2: 1 day, 1 night	65	Drawbridge bearing.	At centre drum.....	More than double that by power.	4.56
Erie.....	C. W. Buchholz. ...	Steam.	5	218	124	2: 1 day, 1 night	65	Pivot bearing	.....	About twice that by power.	3.66
N. Y. C. & H. R...	F. L. Chase.....	Gasoline engine	5¼	100	150	2: 1 day, 1 night	70	Pivot..	.....	$6.00	4.50
C. R. R. of N. J....	William Twining...	Electric	10	.....	125	1: 2 day, 2 night	65	Conical roller.....	Overhead switch.....	10.80	7 00

Tables Driven by Electric Power:

The electric motor through which the power is transmitted is generally mounted on a cast iron, wrought iron or steel frame, properly geared to a friction wheel which runs on the circular rail of the turn-table; this part of the apparatus is commonly called "donkey." It is attached by a pin joint to one end of the turn-table in such a way that the friction wheel runs concentric to the table on the circular rail. The current wires are either brought to the motor by way of an overhead switch, or by means of contact rings—one ring fastened to the centre bearing, the other to the centre cross girders of the table. The donkey and motor are usually covered by a small house for the use of the operator. The current is controlled by a regular street car controller. Generally the power apparatus is provided with an appropriate brake to stop the table at a given point. In some cases sand boxes are provided in the operator's house, to sand the circular rail, to prevent slipping of friction wheel.

The electrical driven turn-table of the Erie Railroad at Jersey City, N. J., differs from the above described apparatus materially; this table is provided with a regular drum and conical wheels similar to a drawbridge. The power of the motor is applied through a gear working in a circular rack around the drum. This table, we understand, is giving very good satisfaction.

Tables Driven by Steam Power:

The equipment consists, generally, of an upright boiler and engine combined, located over the circular rail, and opposite and at right angles to the center of the turn-table, resting on a frame connected with arms, extending to the table girders. The movement of the table can be obtained either by means of a friction wheel on the circular rail, or by means of a circular rack along the circular rail; the former is no doubt the most economical.

Tables Driven by Gasoline Engines:

The general construction of the apparatus is the same as that used on tables driven by electric power, except that, instead of using an electric motor, a gasoline engine is used. The engine is mounted on a wrought iron or steel triangular frame; this frame is hinged at two points to the girders of the turn-table, and supported at one point by a friction wheel on the circular rail. The engine is provided with the necessary friction clutches, speed regulators, and foot brake. The whole is housed for the protection of the apparatus as well as the operator. Under the supporting frame a reservoir is provided con-

taining the fuel used by the engine and a silencer to reduce the noise. A water tank is located in one corner of the house. The water is used to prevent the engine from running hot.

In the opinion of your committee no specific apparatus can be recommended for any location of turn-table; the kind of power and apparatus required or desirable depends upon the location of the turn-table with reference to electric or other power plants.

If electric power can readily be obtained from the railroad company's plant or from outside parties, electricity should be employed, as it requires least machinery, and is economically maintained; where special engine and electric generator would have to be provided, a steam or gasoline apparatus will, no doubt, be more economical and preferable, on account of the first cost of installing the plant, as well as the additional help required to run the engine and generator.

In considering the feasibility of drawing the electric current from an existing railroad plant or a city electric plant, attention should be given as to whether a suitable current is available at all times including nights and Sundays. In a railroad plant, the introduction of the electric turn-table device should not be the only cause of requiring help in the engine room and boiler house, to be on hand nights and Sundays; in such case it will not prove economical to use electricity. It will also not be desirable to have to run a large central electric machine nights and Sundays on account of the turn-tables. In other words, there should be a small dynamo at the central plant for use nights, Sundays, holidays and when shops are idle.

The gasoline engine, where electric power cannot be readily obtained, except by establishing a special plant, is no doubt the most economical; it consumes fuel only when operated, requires less attention than a steam plant, and is generally more adapted for work of this character.

In cities the use of steam power generally necessitates employing a licensed engineer. Further, the supplying of the coal and the removal of ashes all add to the cost and trouble.

The first cost of electric apparatus, ten horse-power motor, controller, donkey, wiring, contact rings, connection of donkey to turn-table, operator's house, etc., complete, is about $1,400; the cost of a steam engine and generator will be about $1,700 additional, if a special or additional plant would have to be installed, making the total cost for an electric motor, including engine and generator, $3,100.

The first cost of a gasoline engine apparatus complete, including gasoline and water reservoirs and operator's house, is about $1,000.

The first cost of a steam engine plant complete is about $1,250.

The foregoing estimates are made up as follows:

Electrical Apparatus without special Engine and Generator.

Ten horse-power motor, carriage, gearing and controller	$800.00
Wiring from power station, assuming distance 500 feet	250.00
Contact rings at centre, or overhead switch frame	250.00
Labor erecting apparatus	50.00
House for use of operator	50.00
	$1,400.00

Electric Apparatus including Special Engine and Generator.

One 6½ inches x 8 inches direct connected engine	$785.00
One ten K. W. engine, type generator including switch board, volt meter, etc.	650.00
Foundation for engine and generator	250.00
Labor installing engine and generator	165.00
One ten horse-power motor, carriage, gearing, and controller	800.00
Wiring from generator to table and motor	100.00
Contact rings at centre of table or overhead switch frame	250.00
Labor erecting apparatus on turn-table	50.00
House for operator	50.00
	$3,100.00

Steam Engine Apparatus.

Steam engine and boiler	$800.00
Gearing and friction wheel	100.00
Frame supporting engine and boiler including guide arms	200.00
Labor erecting apparatus	100.00
House for operator	50.00
	$1,250.00

Gasoline Engine Apparatus.

Five horse-power engine and supporting frame	$850.00
Erecting apparatus	100.00
House for operator	50.00
	$1,000.00

The cost of operating the various machines per day of twenty-four hours, based on turning 250 engines, is about as follows:

Electric Apparatus, without special Engine and Generator.

One day and one night operator at $1.60 per day	$3.20
Cost of electric current	.60
Repairs to electric apparatus and supplies	.10
Oil and waste	.02
	$3.92

Electric Apparatus with special Engine and Generator.

One day and one night engineer at $1.60	$3.20
One day and one night operator of turn-table at $1.60	3.20
Repairs to engine, generator, motor, etc.	.20
Cost of steam for operating engine, assuming that steam can be drawn from existing boiler plant	.50
Oil, waste, and sundry supplies	.15
	$7.25

Steam Engine Apparatus.

One day and one night engineer at $1.60	$3.20
Wheeling coal to table for engine	.25
Coal, lubricating oil and waste	.80
Repairs to engine, boiler, etc.	.15
	$4.40

Gasoline Engine Apparatus.

One day and one night engineer at $1.60	$3.20
Gasoline	.40
Oil, waste, etc.	.15
Repairs to apparatus	.20
	$3.95

The economy of operating turn-tables by power depends on the weight of and the number of locomotives to be turned in a given time. On railroads where only light locomotives are required to be turned on a certain turn-table, the hand power will, no doubt, prove satisfactory and economical.

On some of the Eastern railroads locomotives weighing 175 net tons, including tender, are operated; such locomotives cannot, according to actual experience, be turned economically by hand, especially in the winter time.

The following example will show what power is required to turn one of the above mentioned 175-ton locomotives:

Assume the length of turn-table 75 feet, the center pivot 10 inches in diameter, weight of turn-table including floor and rails, 100,000 pounds. We have for the total load on center pivot 175 net tons, or 350,000 lbs., plus 100,000 lbs., or a total

of 450,000 lbs.; the area of the steel pivot is 78.54 square inches, making the pressure on the bronze disc upon which the pivot operates 5,730 lbs. per square inch; for this pressure we assume the co-efficient of friction between steel and bronze at 0.125, and we have for the friction 450,000 x 0.125, or 56,250 lbs. The moment of friction is equal to 56,250 x two-thirds the radius of pivot, or 56,250 x 3.33″=187,312 inch pounds, or 15,609 feet pounds.

The work to be performed to overcome the 15,609 feet pounds of friction for one complete revolution per minute is equal to 15,609 x 3.1416 x 2 x 1 equals 98,074 feet pounds, or horse power equals $\frac{98074}{33000}$, or nearly equal to 3.0 horse power. To this requirement must be added the power required to overcome the internal resistance of apparatus, the wind pressure against the locomotive, and the rolling friction on end wheels due to unbalanced weight of locomotive on the table; the horse power required as per above calculation should be doubled to insure effective work of power apparatus at all times, therefore 6.0 horse power will be required to operate the turn-table at the rate of one revolution per minute.

Your committee is of the opinion that for heavy service turntables, some motive power should be applied for their operation. Electric power is recommended where the railroad company have their own power plant in close proximity to the turn-table, or when electric power can be purchased from outside parties at a reasonable figure. For points where electric power is not available the gasoline apparatus should be used. Steam power, while satisfactory as to performing the work, is not as economical as either the electric or gasoline apparatus.

The electric donkeys are manufactured by the Milwaukee Electric Co,, Milwaukee, Wis., the Westinghouse Electric Co., Pittsburg, Pa., and probably by other electric manufacturing concerns.

The gasoline engine apparatus is manufactured by Fairbanks, Morse & Company, Chicago, Ill.

The committee desire to express their thanks to Mr. W. W. Atterbury, superintendent of motive power, Pennsylvania R. R., Altoona, Pa., Mr. Charles W. Buchholz, chief engineer Erie R. R., Mr. William Twining, assistant engineer maintenance of way, Central R. R. of New Jersey, and Mr. F. L. Chase, engineer of bridges, N. Y. C. & H. R. R. R., for valuable information furnished. The thanks of the committee are also due to the members of the Association for furnishing information for this report.

Signed,

F. E. Schall,
J. E. Greiner,
B. F. Pickering,
Onward Bates,
Committee.

September, 1901.

DISCUSSION.

Mr. Schall.—I will say that the committee has endeavored to get all the information possible, but the subject is one that has not received much attention heretofore, and therefore the replies received from the members upon questions submitted were limited. Every member of the Association was sent a schedule of questions on the subject in hand, but out of all only six members replied as having power plants in use for operating turn-tables; a number of favorable replies were received from parties not members of the Association; these replies are tabulated and incorporated in the report. Upon comparing the figures in the tables, you will find a great difference in the cost of operating turn-tables, depending, presumably, on the location of table, number of locomotives turned, and the opinion of the party having charge of the accounting, as to what is a proper charge against turning locomotives. In regard to the number of locomotives turned, you will find in the report that as high as four hundred locomotives are handled in twenty-four hours on one of the railroads having power in use for operating turn-tables. I do not wish to enter into the matter of cost of operating any further than to state that it appears that the cost of operating turn-tables by power is about one half the cost of operating by hand. The committee have also investigated the question of cost of installing the various kinds of power plants, and the approximate cost is shown in the report. Electric power is used generally, as will appear from the table in the report; this I suppose is due to the fact that electric power is available, at a reasonable cost, from a plant near the turn-tables. The subject is a new one, and other devices will no doubt be invented for the purpose under consideration. I feel sure the members will find, where a large number of locomotives must be handled, that it will prove a saving in time and expense to equip the turn-tables with power. The report submitted shows fully the economy of operating turn-tables by power; it is not only a question of economy, but often a question of time; we in the East, with heavy locomotives to handle, find it almost impossible at some points to operate turn-tables by hand. The length of turn-tables offers quite a factor in the power required to turn locomotives; if you have a heavy and long loco-

motive to turn on a comparatively short turn-table, it cannot be balanced, and the power required is increased to overcome the extra friction on the circular rail. This extra power can be so much that the installing of a power apparatus is almost a necessity.

President.—This is a live subject and we have an admirable report on it. This question of quickly turning large locomotives is a question of interest to all, and I hope we will have a very full discussion of this report.

Mr. Markley (A. S.).—From Mr. Schall's report, as I understand it, no lock is necessary for holding table in position while engine is being run off, and I would like to ask Mr. Schall if he believes this a safe way to operate a table.

Mr. Schall.—No, there is no lock used, but I believe it to be good practice to use a lock.

Mr. Markley (A. S.).—Another point. Where the table is locked and fouled, I find it very hard to remove the pin, and we have got sometimes almost to take a bar and knock it out in order to release it.

Mr. Schall.—To that I would say, Mr. Markley, that it depends entirely on the lock provided. It should have all the play you can give it, up and down, but the lateral motion must be taken care of, so as to confine it to a minimum.

Mr. Berg.—In regard to the matter of handling electrical devices for operating turn-tables, I would say that there is no more expert knowledge required than by a motor-man on a trolley car, and you all know that any man can be broken into that service very quickly. Further, wherever you have electrically-driven turn-tables, you have an electric plant, and therefore there is somebody around in the vicinity who understands the adjustment of electrical devices and machinery. An ordinary laborer can be worked in at the table very readily, the same as a motor-man on a trolley car. It does not need a high-salaried man to work the turn-table.

Mr. Markley (A. S.).—I would like to ask Mr. Berg as to the question of economy in having power to turn the tables. It seems to me it is a question as to whether it would pay or not to have a little plant especially to turn the table if you have no other use for it.

Mr. Berg.—Mr. Markley has touched the vital point, namely, the question of deciding whether an electrical device for a turntable is the proper thing to instal or not. I have found the general idea prevails that where there is an electric plant at the shops or a terminal station, then all that is necessary is to buy an electric donkey. This is not correct, as a general statement, and there is one point to be considered first. In other words, will they have at the electric power plant a machine that has to be run anyhow in the daytime, Sundays, and nights, and therefore they will not need an extra man to run the plant specially in order to keep up the supply of electricity to turn the table. Where they have electric power running all the time and sufficient of it to draw on for the turn-table at all times, then there is no extra man, or, you might say, expense required to run the electric turning device for turning the table. But if there is only one very large machine that is used at night for lighting purposes, and otherwise is still during the daytime and also Sunday, then the installation of an electric device for operating a turn-table will call for increased expenses. I think that is the vital point in deciding whether an electric table should be put in or not. There is another source of electric supply, the question of city supply, but on investigation of this it will generally be found that they shut the power off in the daytime or Sundays, and the supply is found not to be available when needed. As soon as you leave electrically-driven plants or go to a point where there is no electricity available, the gasoline engine is the proper machine to adopt. It is cheap, and you can operate it with ordinary railroad hands and a class of men who are found around the roundhouse and vicinity, and in case of any breakdown to the gasoline engine there are machinists there that can make the necessary repairs.

Mr. Markley (A. S.).—There is one way by which you can overcome, to some extent, the trouble where electricity is not available during the daytime and that is a storage battery. This can be charged at night and used during the daytime to turn the tables.

Mr. Lichty.—Where the North Western have turn-tables operated by electricity we happen to have power right at the plant, and these are simply connected to the dynamo and the current kept up at all times, and in this way the tables are operated very successfully and economically.

President.—Mr. Eggleston, I understand your road have turn-tables operated by steam plant?

Mr. Eggleston.—I do n't know much about it. The Motive Power department are attaching the steam apparatus. I was looking at it the other day, and I imagined that it was a good arrangement. They are going to use a small, vertical engine, taking the steam from boiler located in the roundhouse used for heating and operating three or four lathes and planers for roundhouse work. The expense will certainly be very small. The steam power necessary will be really of no cost, and one man will be sufficient to operate the table.

Mr. Cummin.—I would say that we have one turn-table and one drawbridge operated by electricity, and with us it is certainly a great saving, not only in the cost of operating, but in the quickness with which the structures are turned, especially the drawbridge. We probably have trains a little thicker sometimes on some parts of our road than most of the members here. I would state that on the fourth day of last July there were three hundred and seventy-nine trains passed over that drawbridge, and the bridge was opened forty times for boats, between the hours of 7 o'clock a. m. and 6 o'clock p. m., and that would mean some work, if you had to operate it by hand power and delay any trains, when they are as thick as that. On the first Sunday of last August there were four hundred and six trains over that drawbridge; you men, I imagine, do n't have as many trains as that. We have a trolley line about half a mile from this drawbridge; we put in a motor and simply connected it with the trolley system, and it makes our power very cheap. We have power night and day, and we save in labor ninety dollars per month, which is pretty good interest on the investment, in addition to the time we save in turning the bridge, which we can do, close, and open it, in one third of the time with that motor that we could before the motor was put in there.

President.—Any more of the members use steam for operating turn-tables?

Mr. Schall.—I would state that I received quite a lengthy report from Mr. Atterbury, superintendent of Motive Power, Pennsylvania R. R., relative to steam plants, but did not bring it along, as I thought the steam apparatus was out of date.

Mr. Berg.—I think it is only correct to state, in connection with the discussion on steam boilers and engines for turning tables, that I recently ascertained that the Erie R. R. had been investigating very thoroughly the question of turning tables and had come to the conclusion that steam-driven tables were more economical than electrically-driven tables. I respectfully question that report, and believe it must be based on one of that class of reports that are so liable to be made by men at shops of any department of a railroad in regard to the efficiency and economy of a plant, and where they leave out a great many items that should be considered. I cannot believe that the steam boiler is more economical. You have got to handle the fuel, take away the ashes, and, if in a city, employ a licensed engineer, and it is my opinion that the repairs on that kind of plant will exceed the cost of repairs to the electric device or gasoline engine.

Mr. Eggleston.—In regard to economy, in the plant I speak of the steam is taken from a boiler now in service, used for heating purposes and running small machinery. That is certainly a good feature, with no extra expense attached to it, and the increased amount of fuel would not amount to anything. The small vertical engine they picked up themselves, and the only machinery purchased outside of what was in stock was twenty feet of link chain and two sprocket wheels, the rest they picked up around the general store supply. So the cost of this plant is going to be very small.

Mr. Berg.—In discussing here the general points indicating the superiority of one class of turning power over another, we should not be misled by description of home-made contrivances and the old idea that steam costs nothing because you draw it from a shop boiler. It all costs money. There are not many turn-tables in the country where a shop boiler is within piping distance. When speaking of the application of steam to turning turn-tables I have in mind the old design of a separate steam boiler located on a platform attached to the table. Where, in special cases, steam can be brought to the table as described by Mr. Eggleston, the conditions are very favorable and the results will be great economy, but this special case cannot stand as the general types we are discussing.

Mr. Carr.—I would like to inquire from these gentlemen if any of them have had turn-tables operated by power in use long

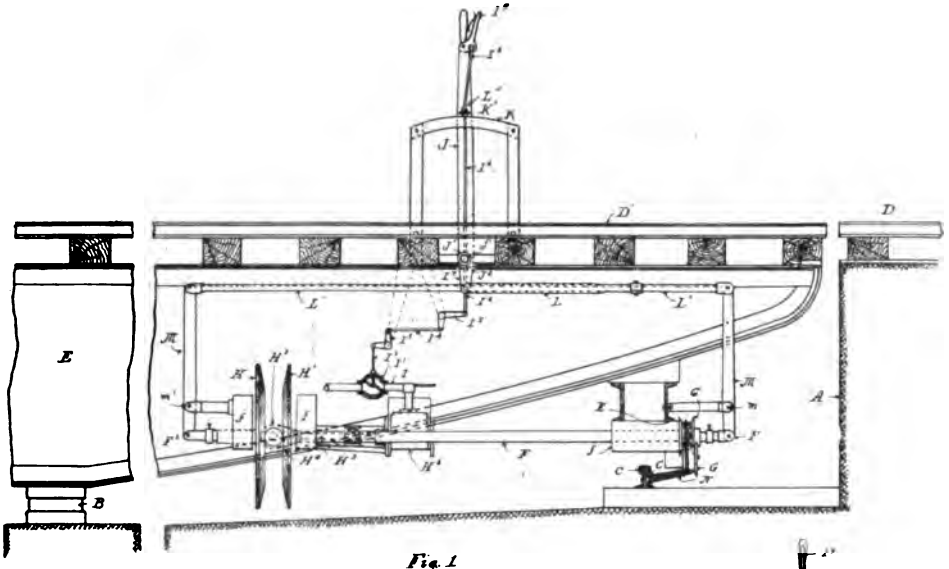


Fig. 1

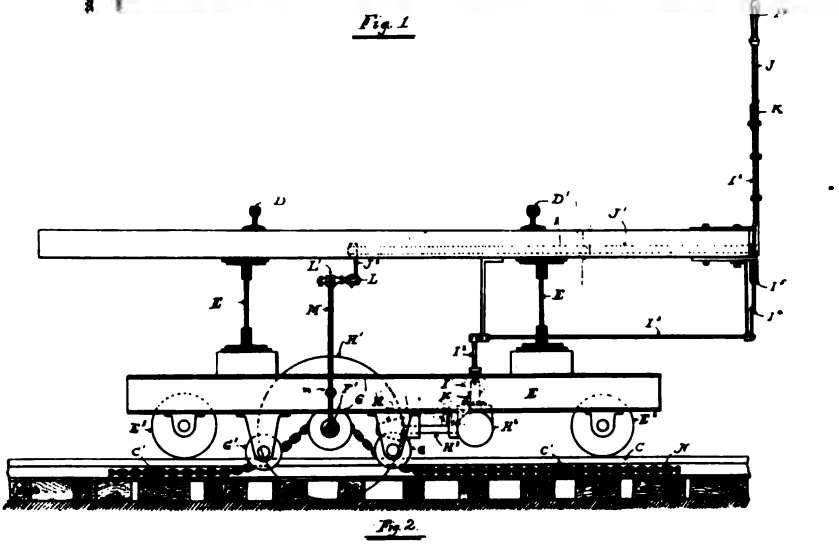


Fig. 2

FIG. 13.—Turning device, Tyrone Shops, Penn. R. R.

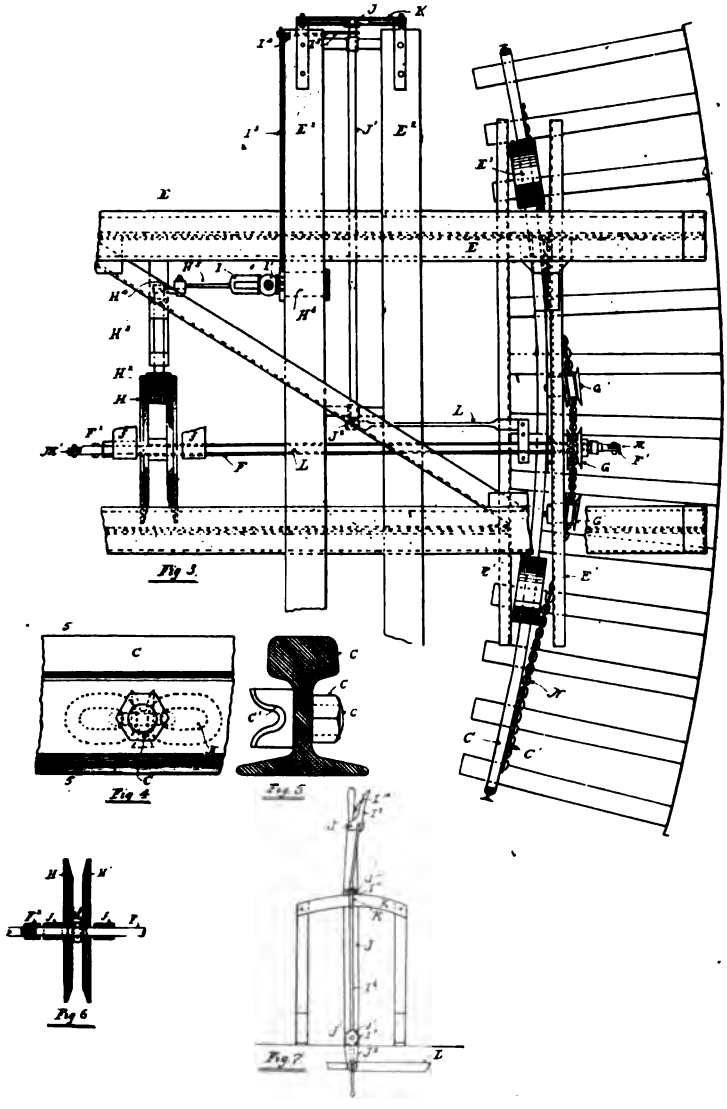


FIG. 14.—Turning device, Tyrone Shops, Penn. R. R.

enough to tell the difference, or give us the cost to operate a table by electricity or by gasoline engine?

President.—There is a statement in the report that shows the cost of electrically-driven tables, steam, and gasoline.

Mr. Carr.—How long have these tables been in operation?

Mr. Schall.—The figures given in the report for operating turn-tables by gasoline engines on the Lehigh Valley R. R., are based on two months' service only, but we kept a close record of all the expenses and found that for twenty-four hours the cost is $3.60, or about one third of the cost of operating the table by hand. The New York Central & Hudson River R. R. have a gasoline apparatus, in service a little over a year; they are saving about $45 per month over the cost of operating by hand. I am quite sure the cost of operating a turn-table by gasoline engine or by electric motor, where electric power can be obtained from a suitable point, would not exceed $4.00 per day of twenty-four hours.

Mr. Carr.—I do n't consider six months, three months, or nine months or twelve, would be a fair comparison to arrive at the actual cost of operating tables by power, it would take a longer time. The machinery would all be new, and there would naturally be no extensive repairs necessary, and it would appear to me in order to arrive at the figures, that it would require not less than one or two years at the least to arrive at a fair comparison, as to the actual cost of operating by power, and the location makes all the difference in the world. For instance, you take it in the northern country, where we have so much snow and ice to contend with, and I think it would be well to consider those things before an absolute conclusion is arrived at, the locations in particular, as to whether practicable to operate with steam, electricity, or gasoline in snow storms.

President.—I think it would be interesting and instructive if we could have reports on the cost of operating tables during the coming year by the various forms of power under discussion. I will therefore ask the following gentlemen to each keep a record of the number of engines turned, number of men used, cost of turning, speed of turning, weather conditions, and in fact make a careful report of the operation of the table they are to report on. Mr. Schall, will you report on the gasoline device, Mr. Lichty the electric, and Mr. Eggleston the steam, and report at our next convention?

Mr. Eggleston.—Mr. President, I will gladly do as you suggest, and, between now and our next meeting, I will get the cost of the operation of our steam plant and tell you all about it.

President.—I would also add Mr. A. S. Markley for the hand power turn-table.

Mr. Cummin.—If it cost Mr. Eggleston nothing except two sprocket wheels and a few feet of chain, how are we going to arrive at the actual cost of the entire plant? It would not be a hard matter to purchase all the material if we can pick up everything except a couple of sprocket wheels and some chain.

Mr. Berg.—I think it an excellent idea to have the different members keep track of their operating expense during the year and give us the information next year, when we discuss this subject again, and I think we ought to get some good information from that. I agree with Mr. Carr that the comparison as between the various styles of motors should be based on the experience of several years, but the leading question to-day is to emphasize the necessity of using some form of power other than hand power for turning tables, and I think in regard to that it is perfectly evident that there is economy in some form of motor, unless you have very light engines and very few to turn in a day. The gasoline engine that has been installed on the Lehigh Valley R. R. handles the heaviest mountain engines that we have, and the number turned in two months was a little over eight thousand, that would be an average possibility of sixty thousand engines a year. Now, with that volume of business in sight and with the experience that we have had, whether steam, electricity, or gasoline, there is no doubt but that it is economy to use power, but as to the relative advantages of one over the other, I believe Mr. Carr's suggestion is a good one. Mr. Schall has certainly gathered information that leads us to adopt the conclusion that electricity is excellent, where you have a plant that is suitable, but it is not every electrical plant that is suitable. Where you have not suitable conditions in an electric plant in the vicinity, or no electricity available, then it seems to me that the gasoline engine is an excellent thing. In regard to operating during snow storms, I have a letter from the chief engineer on the New York Central, of whom I inquired particularly, as to their experience with gasoline-driven tables in New York city during last winter,

and the answer was, absolutely no trouble with the snow, and we did have snow in New York city. I still believe that steam is not the best thing to use, and Mr. Eggleston's description of that home-made contrivance illustrates the point that I have made that in preparing cost of devices we should take into consideration what it would cost if we had to start right in new and get these things together. Nothing has been said to-day in regard to turning tables by air. This has been done. The present bridge engineer on the New York Central R. R. has given me information relative to an experiment he made some years ago on some railroad where they had a home-made contrivance fixed up to turn the table by air, and although located in what you might call a southern country, he experienced some trouble on account of moisture in the air freezing in the winter, and clotting up the valves. I have also found there is a device invented by a man out in Colorado for turning a turn-table by air, using the air from the locomotive by simply attaching a flexible pipe to the compressed air supply of the locomotive. There is a tank provided on one side of the table, so that when an engine comes along that happens to have sufficient air to spare, they fill up this cylinder with air, so that when a dead engine or car has to be turned, then they draw the air from this tank storage cylinder attached to the table. That system has been used since last March on the Union Pacific and is said to work very successfully. The cost of installation is $1,200, or about the same price as installing a gasoline plant. It has not yet been used during a winter season.

Mr. Pickering, by letter, calls attention to a patented device for turning turn-table in use at the Tyrone shops of the Pennsylvania R. R., said to have been in use for two years and a half. The plan indicates that the device is applicable to any form of motor, whether electricity, gasoline, steam, or air. The interesting feature in connection with this turn-table is that compressed air is used to turn the table, using the air in a steam engine. The air enters through the center pedestal of the table and is connected over center with swivel joint. Prior to the installation of the air supply passing up through the center pedestal, the air for the turning engine was taken from the air supply of the locomotive to be turned. Subsequently the supply through the center pedestal was installed.

VI.—Water Stations. Best Material for Foundations, Tanks, Substructures, Connections, Capacity, etc.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

The committee appointed at the last annual meeting to report on water stations, best material for foundations, tanks, substructures, connections, capacity, etc.

It would be impossible for the committee to designate the various materials used in the construction of permanent water stations in all parts of the country. The material used so varies that it would not be advisable to undertake to say just what material should be used in their construction.

On March 10, 1901, the committee sent out 125 circular letters to members of the Association as well as others, embracing 20 different questions, as follows:

What is your standard permanent water station?
In detail as follows: (Send plan of standard Devices.)

1. Tank, foundation, material, etc., piers, only cost of same.
2. Tank substructure, wood or iron?
3. Standard height of bottom of tank above rail.
4. Size and capacity of tank.
5. Number of hoops and size.
6. Description of hoop lug.
7. Description of frost box and any additional provision made to prevent pipes freezing under tank.
8. Any provisions made to prevent water from freezing in tanks? Please describe them.
9. Where is delivery of water made from pump into tank? Why?
10. Elevation of tank outlet spout above rail.
11. What is your standard water column? Size.
12. What is size of lead pipe from tank to water column? If larger than water column, where do you reduce it?
13. Elevation of water column outlet spout above rail.
14. Description of manholes to water column pit.
15. What arrangements are made for drenching stock at water columns?
16. What provisions are made for washing out pump boilers?

17. How is gasoline for gasoline pumping engines stored? (Describe connections from storage to pump.)

18. From where do you get your supply of gasoline and how is delivery made to pumping plants, barrels, tank car, or wagon?

19. What is standard size of pump house, for steam and for gasoline pumping plants, and cost of same?

20. What provisions are made for coal storage?

Any information of special devices or general plans bearing on the general subject and not covered by these questions will be highly appreciated.

Especial information is desired on the practicability of adopting steel tank in cold climate, style of steel tank used, and location. Comparative cost of same.

Please let me have your reply by May 1st, that ample time may be given committee to formulate the report in time for secretary.

Attached find report from J. M. Caldwell, Chicago, Indianapolis & Louisville Ry.:

1. Stone piers of Bedford Oolitic stone, costing for masonry per yd. $3.05.

2. Wood, white pine.

3. Twenty-four feet.

4. Twenty feet by 24 feet, 66,000 gallons.

5. Sixteen Patent 3-lug, Fairbanks, Morse & Co.'s make from 2 to 6 inches.

7. See plan of frost box.

8. No provisions whatever and have very little trouble with water freezing in tanks.

9. Through bottom of tank in frost box, delivery pipe extending from above the inside of bottom of tank.

10. Eleven feet 0 inches.

11. Poage 10 inches water column.

12. Ten inches through from tank to column.

13. Eleven feet 0 inches.

14. Two feet square at either side of base of column.

15. As a rule we tap the main 10-inch pipe from tank to column and use one and one-fourth inch hose. Where no column is used, we tap the tank and use an ordinary globe valve for shutting it off. This is taken down in the fall and stored till spring.

16. Pressure from tank.

17. Stored in tank underground at least 30 feet from engine. Galvanized iron pipe. Shut-off cocks in basement also at engine.

18. Delivered to pumper in barrels. He stores it in reservoir.

19. Sixteen feet x 16 feet, and the same for gas as for steam pumps. $450 where heavy foundations are used. Where cellars are not used and pumps are placed in the house, $384.

20. Where coal is used, we have bins for storing it, 30 feet long.

We have just installed two gasoline pumping stations on our line, of the Otto pattern. Up to date they seem to give good satisfaction, and if they prove to be a success, in the next few years we will likely install several more. One of these is run by the agent and the other by the car repairer.

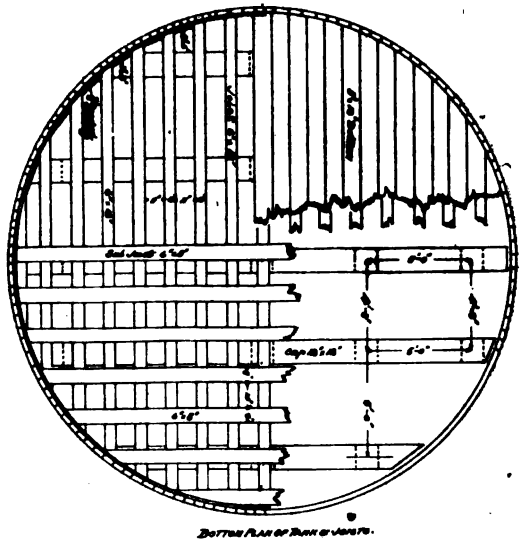


FIG. 15.—Chicago, Indianapolis & Louisville R. R. Standard Water Tank.

Attached is a set of plans for one of our standard water tanks. One of these tanks complete, not including any tank fixtures from the tank to the column or to pump, will cost $1,445.49.

Following is report of W. O. Eggleston, master carpenter of the Erie Railroad :

1. Substructure, steel, tank foundation, concrete piers, cost $5.50 per yard.

3. Height of bottom of tank above rail 30 feet.

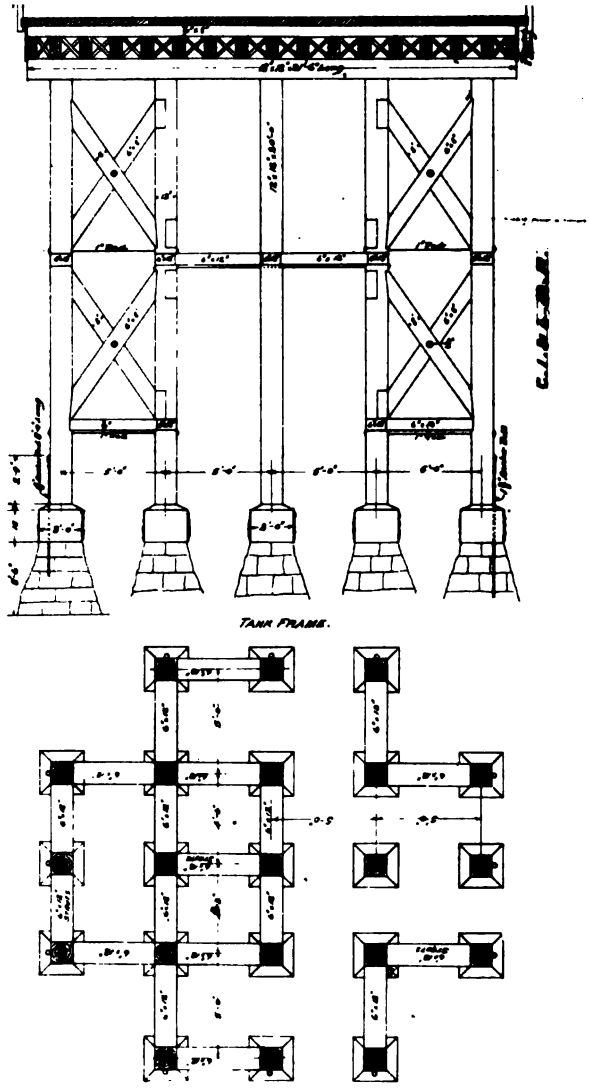


FIG. 16.—Chicago, Indianapolis & Louisville R. R., Standard Water Tank.

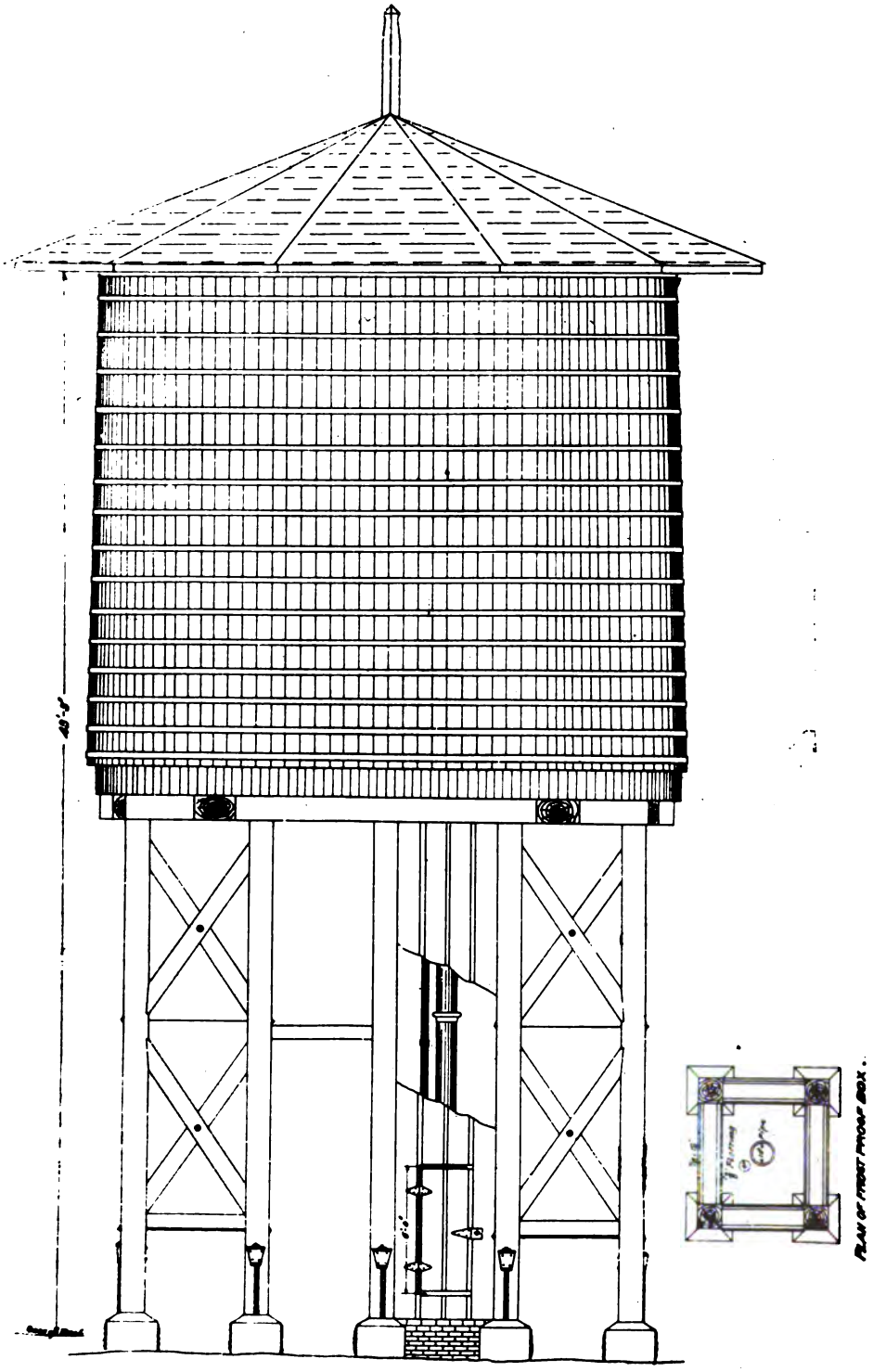


FIG. 17.—Chicago, Indianapolis & Louisville R. R. Standard Water Tank.

4. Size of tub 16 x 24.

5. Thirteen hoops, U. S. Wind Eng. & Pump Co.'s standard.

6. Double bolt lug.

7. We make a hollow brick wall frost proof box.

8. No.

9. Delivery of water to tank is through frost box so there is no necessity of extra frost proof box for pipe.

10. Twelve feet.

11. Sheffield & Mansfield 10-inch standpipe.

12. Ten-inch and 12-inch. Where 12-inch is used and 10-inch standpipe, we reduce section of pipe back of valve or base of standpipe.

13. Thirteen feet.

14. Trap door.

15. None at stand pipes. At tank, where close to track we use hog drenchers for both decks.

16. Tank pressure.

17. Not ready to report on this question.

18. Not ready to report on this question.

19. Fourteen x 12 feet for steam.

20. Coal bins inside.

The following is cost to put in new water plant at Lima, Ohio :

Steel trestle, 30,270 lbs. at $2.25,	$832.43
1 16 x 24 tub, pine,	275.00
1 49 ft. iron ladder,	18.00
1 lb. sheet copper,	.18
40 lbs. yellow metal slate nails,	7.20
128 ft. galv. ridge roll,	3.84
6 sheets of tin, 20 x 28 inches,	1.40
9 squares 14 x 24 sea green slate,	27.00
9 squares tar paper,	2.70
1 pc. pine 8 x 8-16,	1.53
1 pc. pine 8 x 8-8	.77
1 top ornament,	2.57
6 pcs. oak 4 x 6-24 s4s,	5.18
2 pcs. oak 4 x 6-20 s4s,	1.44
2 pcs. oak 4 x 6-12 s4s,	.86
1 16 ft. ladder inside of tub,	1.50
28 pcs. pine 2 x 6-16,	7.17
28 pcs. pine 3 x 6-16,	10.75
20 pcs. pine 2 x 4-16,	3.52
20 pcs. pine 2 x 8-16,	6.72

20 pcs. pine 2 x 12-16,	$10.24
70 pcs. pine 1 x 12-16 sis,	20.16
10 pcs. pine 1 x 5-16 sis,	1.12
10 pcs. 1 x 4-16 sls,	.96
8 pcs. 1 x 6-16 sls,	1.02
95 ft. of 5-inch crown moulding,	2.88
128 feet of 1-inch 1-4 round,	.45
60 feet pine ceiling,	1.50
2 pair 8-inch strap hinges,	.20
2 pair 8-inch hasps,	.10
5 lbs. 8d nails,	.10
100 lbs. 10d nails,	2.00
50 lbs. 30d nails,	1.00
8 gal. 54 paint,	8.80
5 gal. 57 paint,	5.50
1-2 gal. 53 paint,	.55
1 gal. Japan,	.90
3 lbs. lamp black,	.39
28 bbls. Buffalo cement,	28.24
35 bbls. Portland cement,	63.00
3 bbls. white lime,	1.80
30 yds. crushed stone,	10.50
31 yds. sand,	15.50
9,000 brick,	63.00
Mason labor,	239.12
Carpenter labor,	186.91
	$1,865.70

PLUMBING.

1 10-inch Mansfield standpipe complete,	225.00
10 3-4 tons 10-inch cast pipe,	236.50
1 12-foot length 10-inch flanged pipe,	17.26
3 10-inch elbows and 1 10-inch sleeve,	35.00
552 lbs. lead,	24.15
130 feet 3-inch galv. pipe,	47.27
1 3-inch Worthington meter,	78.00
1 3-inch gate valve,	3.65
1 2-inch angle valve,	2.50
4 pr. 3-inch pipe flanges, sheet rubber, 1 16-inch flange ring,	4.90
6 3-inch nipples, 4 3-inch elbows, 1 3-inch tee,	1.50
70 feet 4-inch sewer pipe,	2.30
Iron grating for drain pit,	3.50
1 galv. iron float automatic beam and chain,	3.80
Labor of plumbers,	153.23
	$838.56
	1,865.70
Total,	$2,704.26

Following is report of J. H. Markley, master bridges and buildings of the Toledo, Peoria & Western Ry. Co.:

1. I am using exclusively concrete foundations; have just completed the third one according to plans herewith. Cost $145.38.

2. This company uses long leaf pine substructures.

3. From the inside, of top of bottom to top of rail is 12 feet 6 3-4 inches.

4. Sixteen feet x 24 feet, 49,000 gal.

5. Thirteen hoops.

6. We use such lugs on the hoops as are furnished by the firm from whom we buy our tanks.

7. We put no protection around the discharge pipes and experience no trouble by freezing. As soon as the pumper quits pumping, he drains the pipes. At stations where we have lead pipes, it is necessary to protect them. This is done by double ceiling inside and outside of the four center posts. For this I use No. 2 fence flooring, selecting enough of the best for the outside or exposed siding. Between the two thicknesses of flooring, I use a good quality of building paper.

8. No preventatives used to keep water from freezing.

9. The discharge pipes extend up through center and about 3 or 4 inches above top of staves of tank. It is put in in this way for various reasons. One is, to get a back pressure to wash out and fill the boiler. This is done by putting in a 2-inch valve about 12 inches above tank bottom. Another reason is, I think, it adds to the appearance and costs but very little, if any, more. Where appearance costs nothing, I believe in showing it.

10. Eleven feet 4 1-2 inches to center.

11. Have but one. That is 8-inch.

12. Eight-inch and too small.

13. Twelve feet.

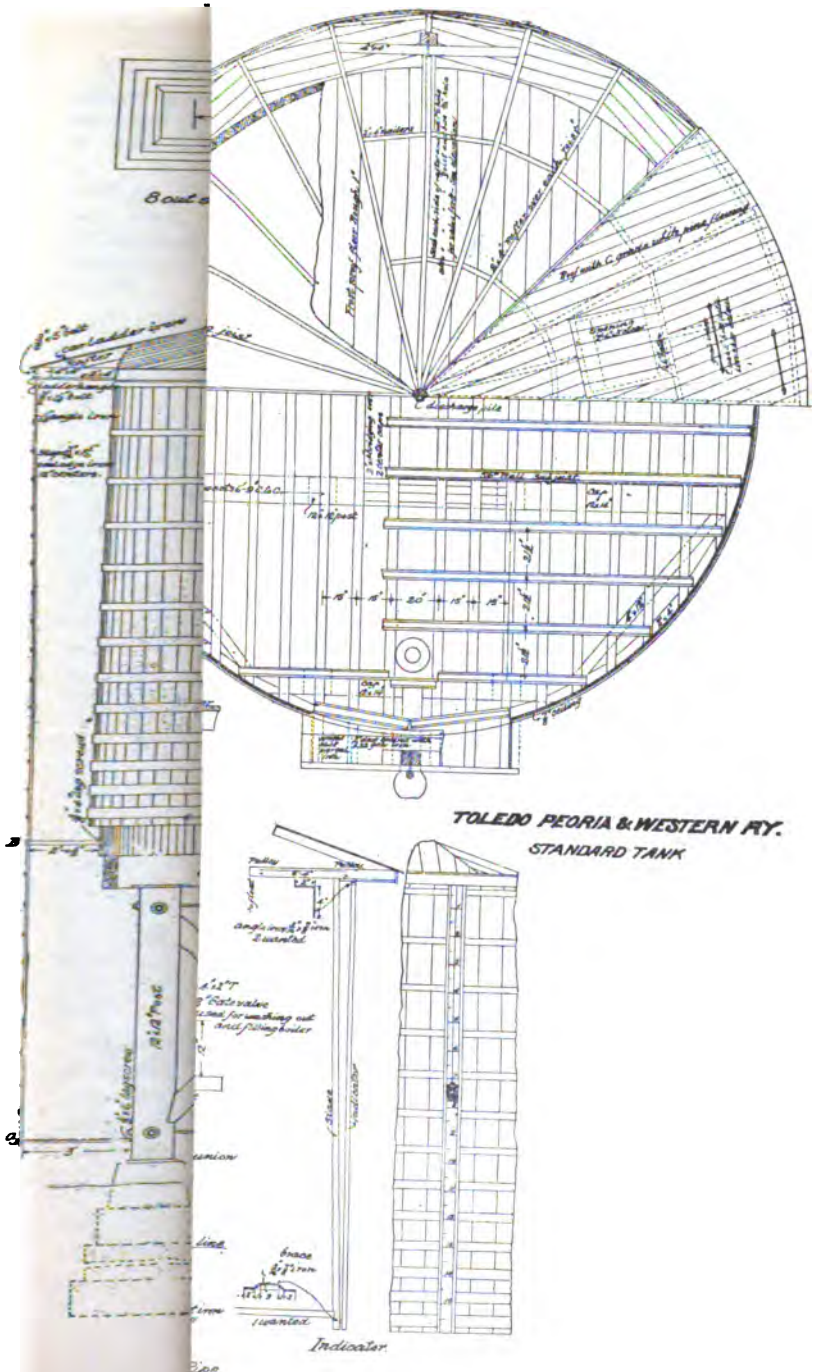
14. Wood. When renewals are made, it will be made of iron.

15. None.

16. This is answered in connection with No. 9.

17. Gasoline is stored in a galvanized iron tank made for the purpose. It is located outside of building in a brick vault built for the purpose. Connection is made from tank to the pump with a pipe. The size is governed by the size of the pump, generally 1-4 inch to 3-8 inch.

18. Gasoline is delivered from the wagon.


TOLEDO PEORIA & WESTERN RY.
STANDARD TANK
Indicator.

19. We have never built any pump houses especially for gasoline pump engines. Our standard houses are frame, 12x28, 10 feet high, sided up with drop siding. Ten feet of one end is partitioned off to keep a small supply of coal and kindling in. It is lined with No. 2 fence flooring. The engine room end is double lined with No. 2 fence flooring, the best selected for the ceiling and exposed sides. Between the two layers of lining a good quality of building paper is put in and a 1-inch dead-air space. The floors where we have steam pumps are of brick. Where gasoline pumps are used we have wood.

20. In addition to the provisions made in the standard pump houses for coal, as explained under question 19, we make a bin large enough to store one carload of coal slack (as that is the kind of fuel used), a reasonable distance, say 20 feet, from the pump house.

In addition to the information submitted I might mention a few ideas that would be of interest. This question I am often asked, Which is the best hoop, steel or good iron? After using one set of the former I have abandoned their use. I find they rust very badly where you cannot see the defect; that is, next to the stave. I now specify good iron, and paint them two coats of red lead and oil before they are put on. For the bottom joist I am using old 52-lb steel rail. This is done in order to reduce the bearing surface on the tank bottom, and by doing this, too, you reduce the space for holding moisture, which is very necessary about a water tank. In tearing down old tanks, or any old structure, I watch where the defects are and guard against them in erecting a new one, and one of the worst defects is caused for what I have substituted the steel rail for.

As an example: In September, 1896, I put a new bottom in a 24-foot tank, of which the staves were good for at least six years. It was an experiment with me, for which I was quite sure of success. The job cost $143, and the tank is still standing and from all appearances is good for at least one more year. At that time the staves will have stood twenty-three years. When I was tearing out the old bottom many places were but one half to three fourths of an inch thick directly over the joist.

Following is report of C. P. Austin, superintendent bridges and buildings of the Boston & Maine R. R.:

1. Foundation. Brick piers, with brick pit in centre the size of the four centre posts, for pipes. Cost complete, $242.

2. Wood. I use the U. S. Wind Engine Co.'s tank complete, with hoops, lugs, etc.

3. 22 feet above rail.

4. 16x24 feet, 50,000 gallons.

7. Posts 12x12. Between posts use 2x12 stud, covered with ruberoid paper on both sides, then sheath, making an air space between. This will keep out frost better than any filling.

8. None.

9. Enter at the top, for the reason that some of my tanks are supplied from city water-works. Use a floating ball cock to shut the water off when tank is full. Where pumps are used, use a tell-tale, operated by a float.

10. About 11 feet.

11. Fairbanks, Morse & Co. and the Waterville, both 8 inches.

12. I do not use any lead pipe. Use 8-inch C. I. pipe from bottom of tank to water column direct.

13. About 12 feet.

14. Use 3-inch hard pine platform over pit, with manhole of iron frame, and cover 16x18 inches.

15. None.

16. Use ¾-inch hose connected to 8-inch pipe from tank to water column.

17. Use none.

19. 10x12x9 feet high for steam pumps and boiler, with brick floor. Cost, $120.

20. Coal box outside of house. Some of our divisions use gasoline, but there is none used on this (Western) division. Use from No. 4 to No. 7 Blake pump.

Following is report of Geo. W. Smith, assistant superintendent bridges and buildings of the Chicago, Milwaukee & St. Paul Ry. Co.:

1. 16x24 water tank, foundation only, cost about $350. Tank complete on foundation, total $1,200. This includes fixtures for delivering water to engines direct from tank.

2. For framework between foundation and top we use wood up to posts 20 feet long. Above that we prefer steel, but are governed by circumstances.

3. For tanks delivering direct to tenders our standard height is 13 feet 6 inches from top of rail to bottom of tank. This is to be increased to 14 feet or 14 feet 6 inches.

4. 16x24, 50,000 gallons.

5. See plan.

6. We use galvanized hoops, and our practice regarding lugs is determined by what the market has to offer.

7. See plan. No additional proofing, except wherever possible an open box along pipe from the well to the frost proofing.

8. In our coldest territory, at points where water is not taken frequently, it sometimes seems desirable to adopt some device to keep the water from freezing in the tub. With our standard construction and increased traffic, however, this is seldom necessary. Where we use creek water or lake water, instead of well water, the tendency to freeze is increased, and we sometimes enclose the whole frame work under the tank and keep a fire inside. The stovepipe, if the tank is constructed with the expectation of using a stove, can be led into a wrought iron pipe running up through the tub. Any device of this sort is undesirable, and is avoided except in cases of well-defined necessity.

9. Water from the pump is delivered into the tank near the outlet valve, and the discharge pipe is either directed toward the valve or a deflecting board is provided to make sure that no ice accumulates around the valve.

10. See plan.

11. We are at present using the No. 6 water column furnished by Fairbanks, Morse & Co. We use the 10-inch size.

12. The size of the pipe leading from the tank to the water column depends on the distance between the two and the height of the tank. The way to design appliances for delivering water to tenders is to begin with the requirements of the situation. At many points the fast trains stop for other purposes than taking water, and money expended for the fast delivery of water is not economy. Where the length of the stop is determined by the time required to take water, the number of gallons per minute considered reasonable will be the gauge for the construction of the appliances, and the standpipe must be of sufficient size so it can be properly handled by one man while delivering the requisite volume of water. If the diameter is too small, the delivery can be secured by added height, but the velocity will be such as to make the standpipe unmanageable, and the result will be that the fireman will never fully open the valve and the desired result as to speed will not be secured. The question of the effect of water velocity on the operation of the standpipe depends considerably on the style of the appliance, and should necessarily be considered separately for each pattern. We consider a flexible spout as necessary, and with that sort of a standpipe the water velocity can be made so great as to throw a man off the tender, hence the necessity of making the standpipe large enough to discharge the desired quantity of water per minute without excessive velocity. The size of the pipe leading from the tank to the standpipe must be considered in connection with the height of the tank. Under ordinary conditions it will probably prove cheaper to increase the size of the pipe than to provide the necessary head to overcome the friction in the smaller pipe. Where distances are extreme it is often economical to put up a small tank close

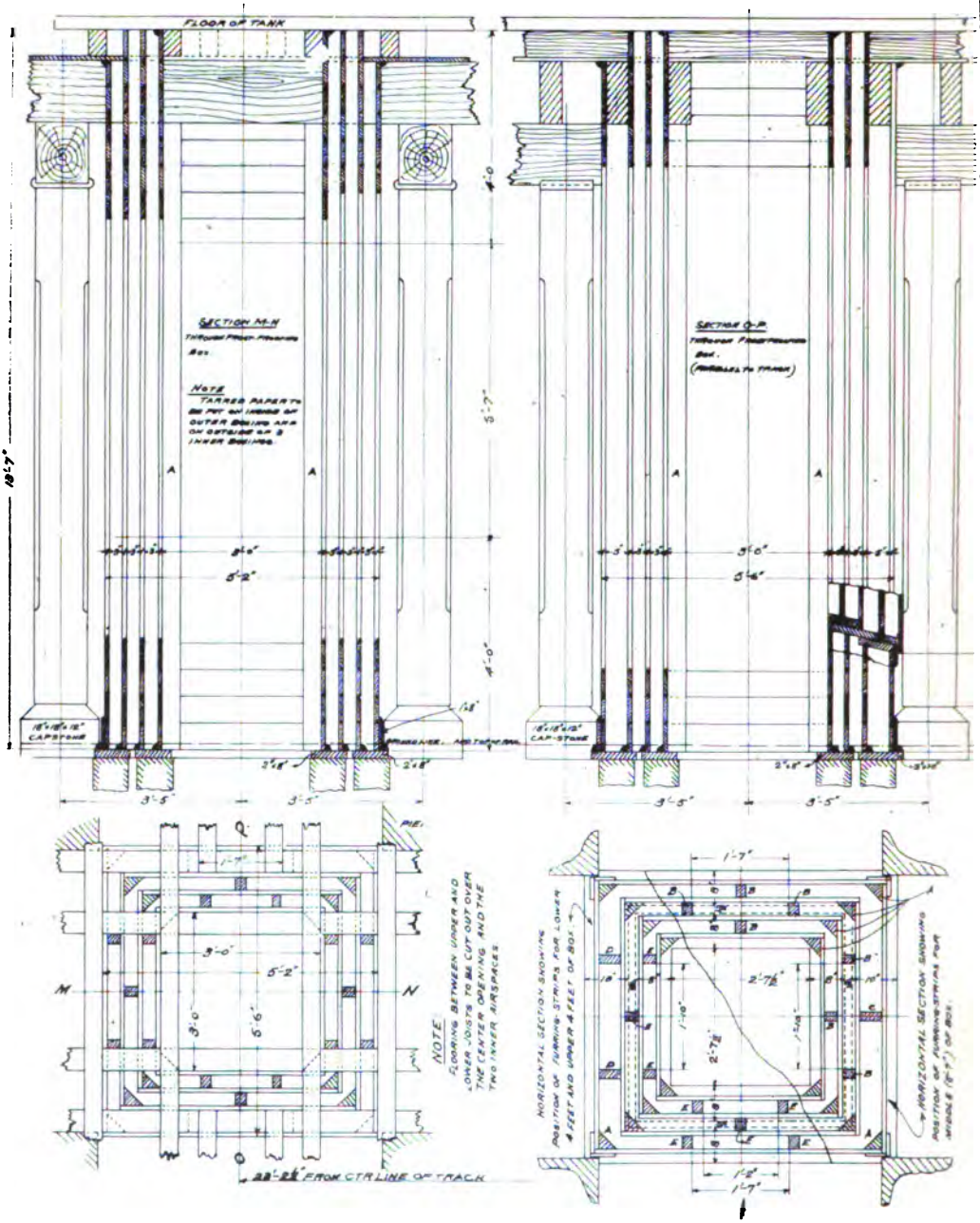

FLOOR OF TANK
SECTION M-N
NOTE
TARRED PAPER TO BE PUT ON INSIDE OF OUTER BOLING AND ON OUTSIDE OF INNER BOLING.
SECTION O-P
CAP STONE
NOTE
FLOORING BETWEEN UPPER AND LOWER JOISTS TO BE CUT OUT OVER THE CENTER OPENING AND THE TWO INNER AIRSPACES
HORIZONTAL SECTION SHOWING POSITION OF FURRING STRIPS FOR LOWER 4 FEET AND UPPER 4 FEET OF BOX
HORIZONTAL SECTION SHOWING POSITION OF FURRING STRIPS FOR MIDDLE (8'-0") OF BOX
FROM CTR LINE OF TRACK

FIG. 19.—Standard 16 x 24 ft. Water Tank, Frost Proofing and Foundation Plan, C., M. & St. P. Ry.

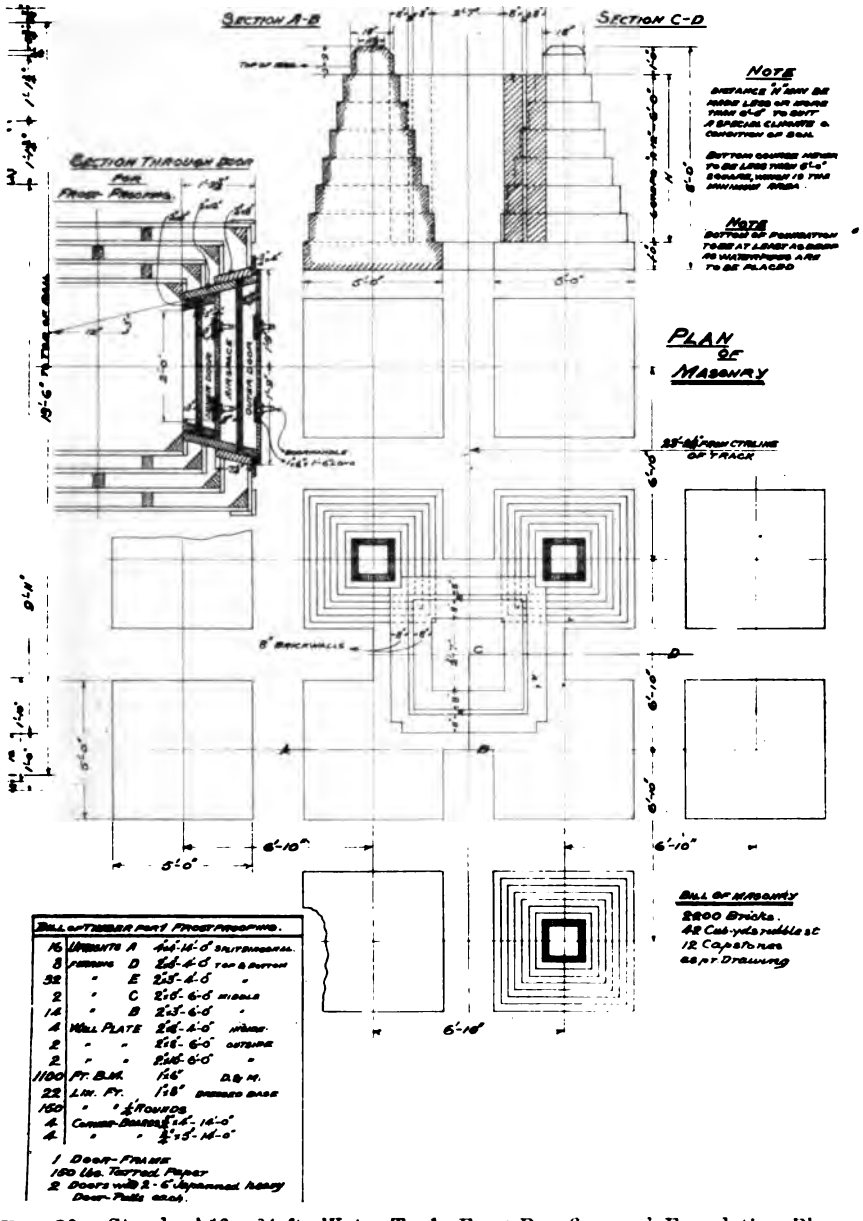


FIG. 20.—Standard 16 x 24 ft. Water Tank, Frost Proofing and Foundation Plan, C., M. & St. P. Ry.

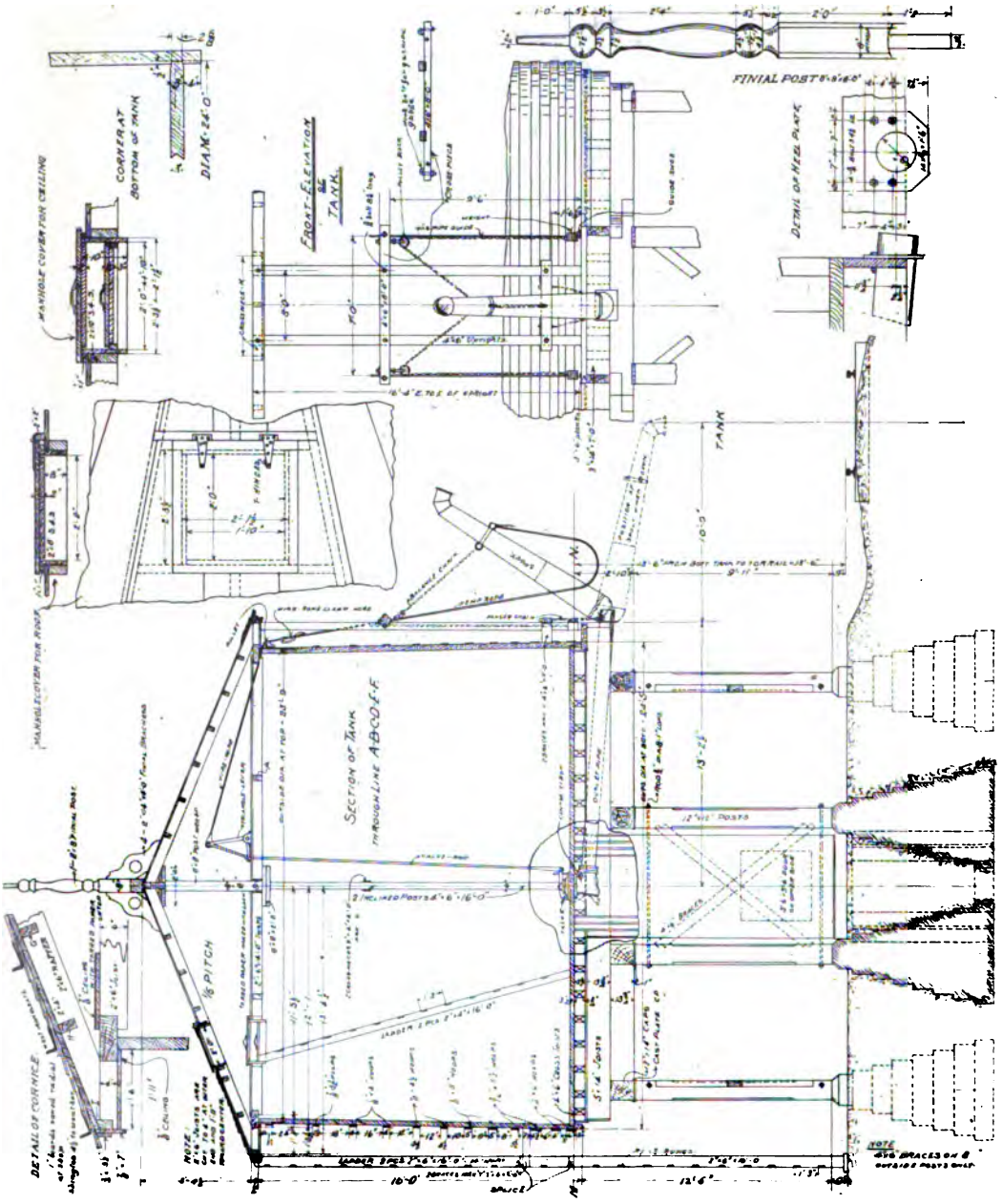


FIG. 21.—Standard 16 x 24 ft. Water Tank, General Plan, C., M. & St. P. Ry.

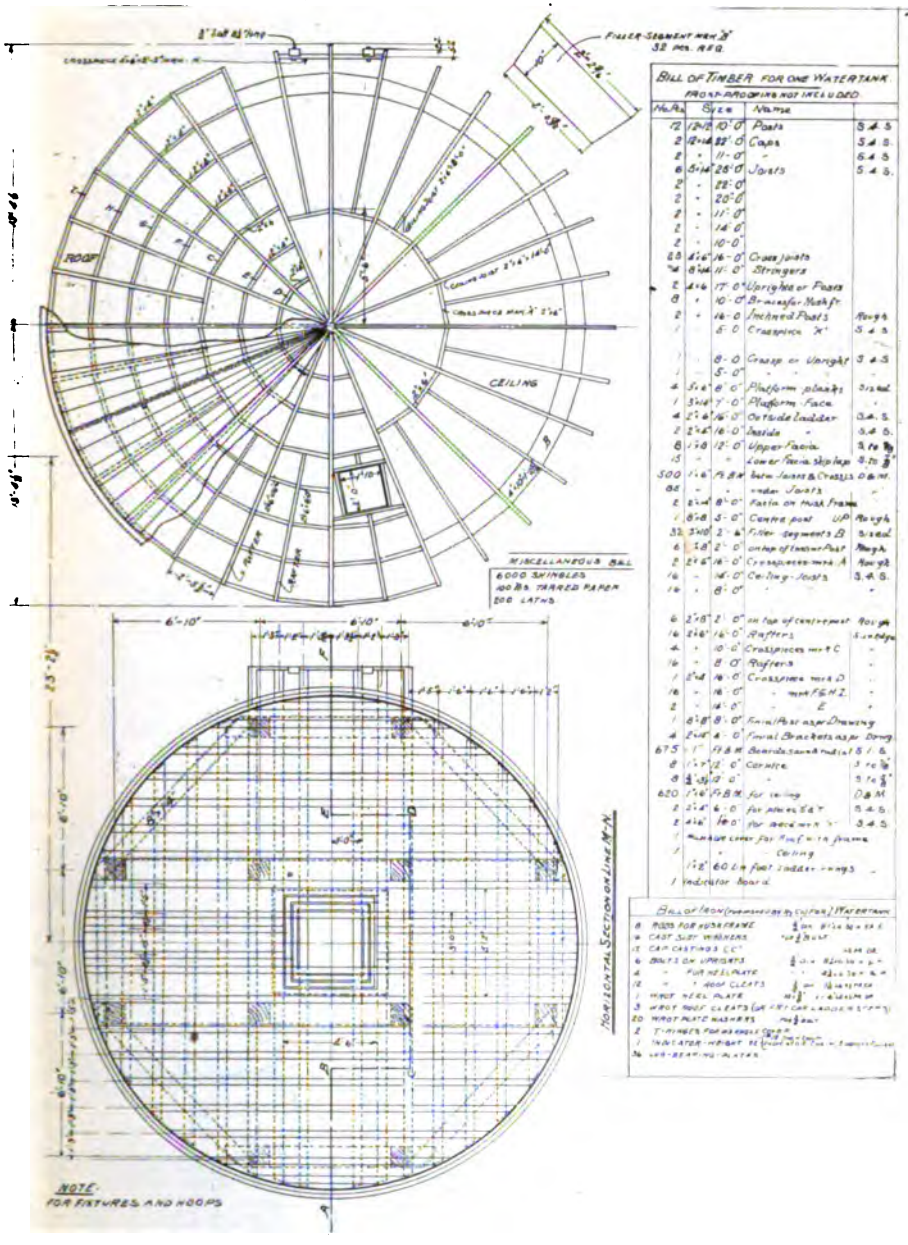
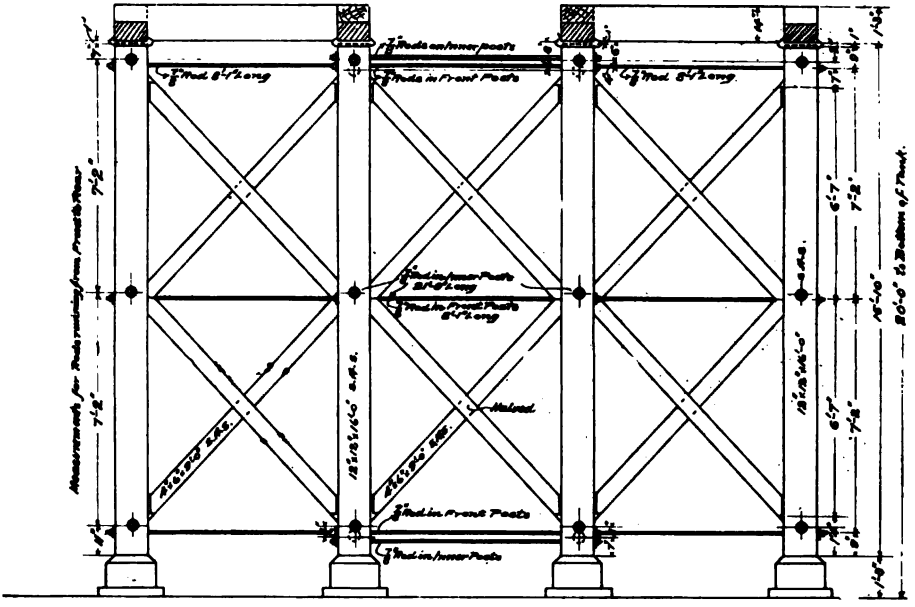


FIG. 22.—Standard 16 x 24 ft. Water Tank, General Plan, C., M. & St. P. Ry.



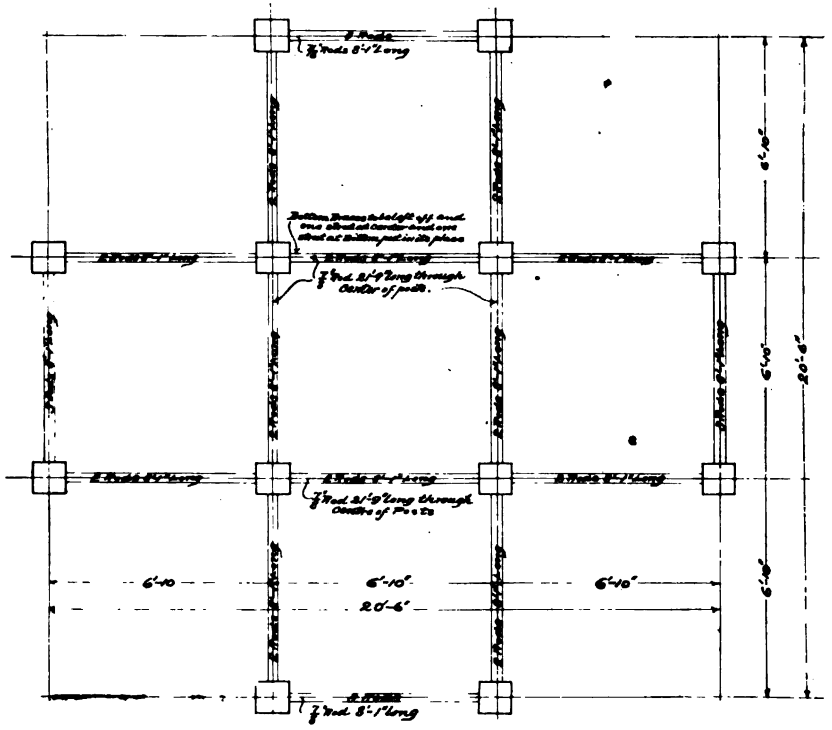
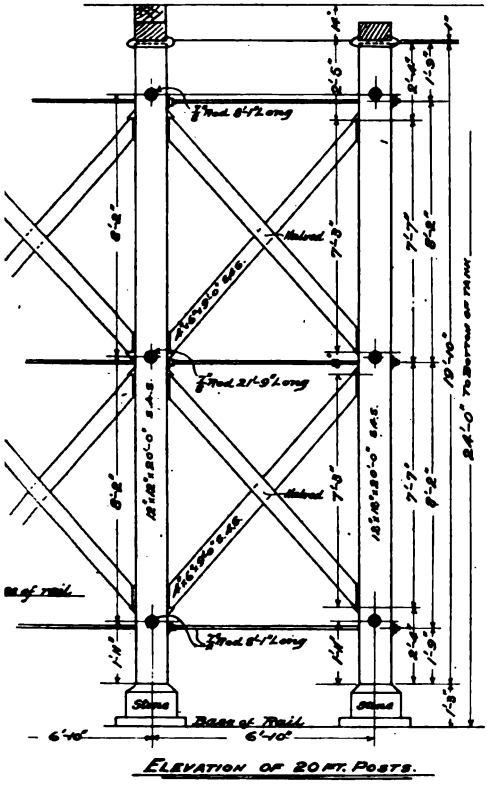

7 Rods
7 Rods 8'-1/2 long
Bottom Beams to be left off and one about at Center and one about at Bottom, put in in place
7 Rod 2'-9 long through Center of posts.
7 Rod 2'-9 long through Center of Posts
6'-10"
6'-10"
6'-10"
20'-6"
6'-10"
6'-10"
20'-6"
7 Rod 8'-1 long

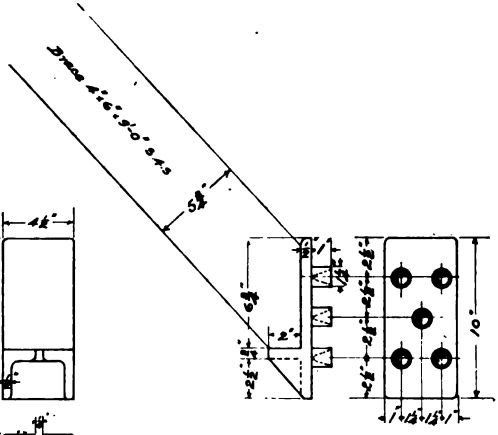
FIG. 23.—For Standard 16 x 24 ft. Water Tank, C., M. & St. P. Ry.



ELEVATION OF 20 FT. POSTS.

BILL OF MATERIAL WITH 16' POSTS		
12	Posts 12"x12"x16'-0"	S.4.S.
64	Braces 4"x6"x 9'-0"	"
36	Rods ⅞"x8'-1" long, Sq. Nut on each end.	
4	" ⅞"x2'-9" " " "	
80	⅞" Cast Washers	
62	Cast Iron Brace-shoes	△ 626

BILL OF MATERIAL WITH 20' POSTS		
12	Posts 12"x12"x20'-0"	S.4.S.
64	Braces 4"x6"x12'-0"	"
36	Rods ⅞"x8'-1" long, Sq. Nut on each end.	
4	" ⅞"x2'-9" " " "	
80	⅞" Cast Washers	
124	Cast Iron Brace-Shoes	△ 626



RUSH FRAME-BRACE-SHOE
62 REQ. FOR 16'.
124 REQ. FOR 20'.

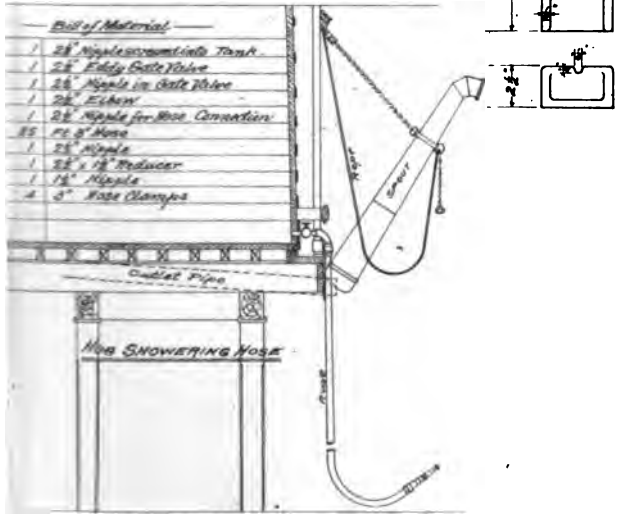


FIG. 24.—For Standard 16 x 24 ft. Water Tank, C., M. & St. P. Ry.

to the standpipe and feed it through a 4-inch pipe from the storage tank at a distance.

13. Water column outlet is 11 feet 6 inches above top of rail.

14. Ordinarily a rectangular opening with double covers and without hinges.

15. See plan.

16. Hand pumps.

17. Galvanized sheet steel tanks, lower than the engine, so that the supply has to be secured by pumping instead of gravity.

18. Gasoline purchased in barrels by the purchasing agent and shipped by freight to the point where used. One or two barrels at a time as are needed.

19. Variable.

20. Variable.

Regarding steel tanks, I refer you to the Chicago Bridge & Iron Company, 105 Throop St., Chicago, who make a specialty of this class of structure, and issue an illustrative pamphlet. We have never built any on this line.

Following is report of Charles Carr, superintendent of buildings of the Michigan Central R. R. Co.:

The standard tank of the M. C. R. R. is 30 feet in diameter, with an 18-foot stave built on a substructure 24 feet in height placed on concrete piers; the bottom and staves are of cypress, the balance of tub and substructure of white pine.

I enclose a blue print of our standard tank, which is correct except that staves are 18 feet instead of 16 feet in length, and 15 instead of 13 hoops are used. The draftsman also shows a plate on top at posts, but we have very few of them on our tanks, the cast corbal shown on the upper left hand corner being used in its place.

I have had no experience with iron tanks, but I think an iron substructure to be the support for the coming tank.

1. Most of our tanks stand on stone piers, but all new tanks built in the last two years have been built on concrete piers.

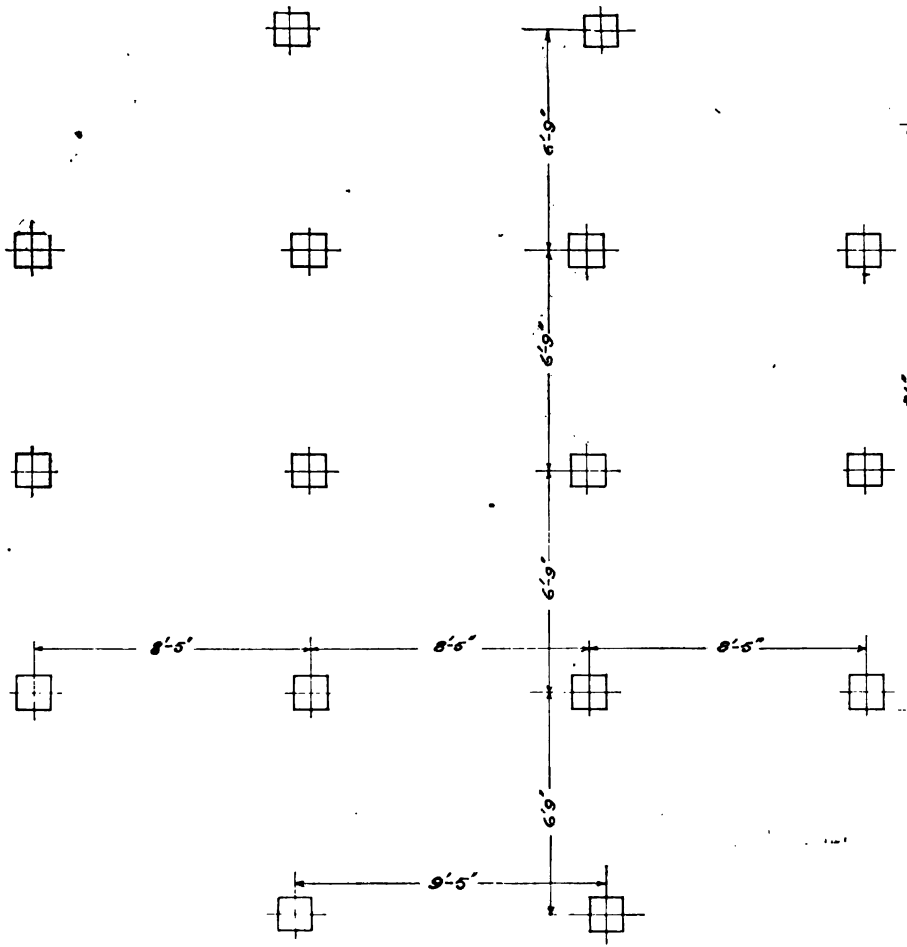
2. Substructure; white pine post, girts, and braces.

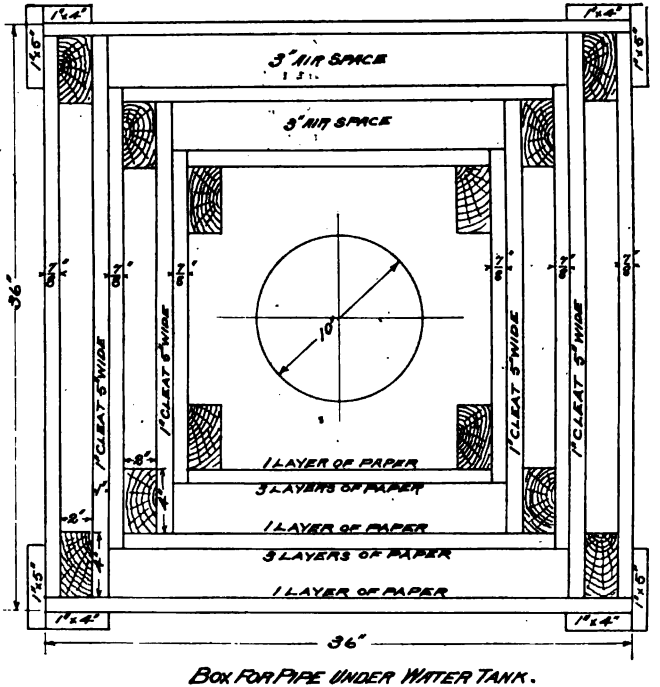
3. Our tanks stand 28 feet 3 inches above rail when placed on 24-foot posts.

4. Our standard tank has a 30-foot bottom and 18-foot stave. Capacity, 88,000 gallons.

5. 15 hoops are used: 3, ¼x5 inches; 2, ¼x4½; 6, ¼x4; 4, ¼x3.

6. Hoops are fastened with a lug made by the Winship Mfg. Co., of Racine, Wis.





BOX FOR PIPE UNDER WATER TANK.

FIG. 26.—Foundation Plan 16 x 30 ft. Water Tank, Michigan Central R. R.

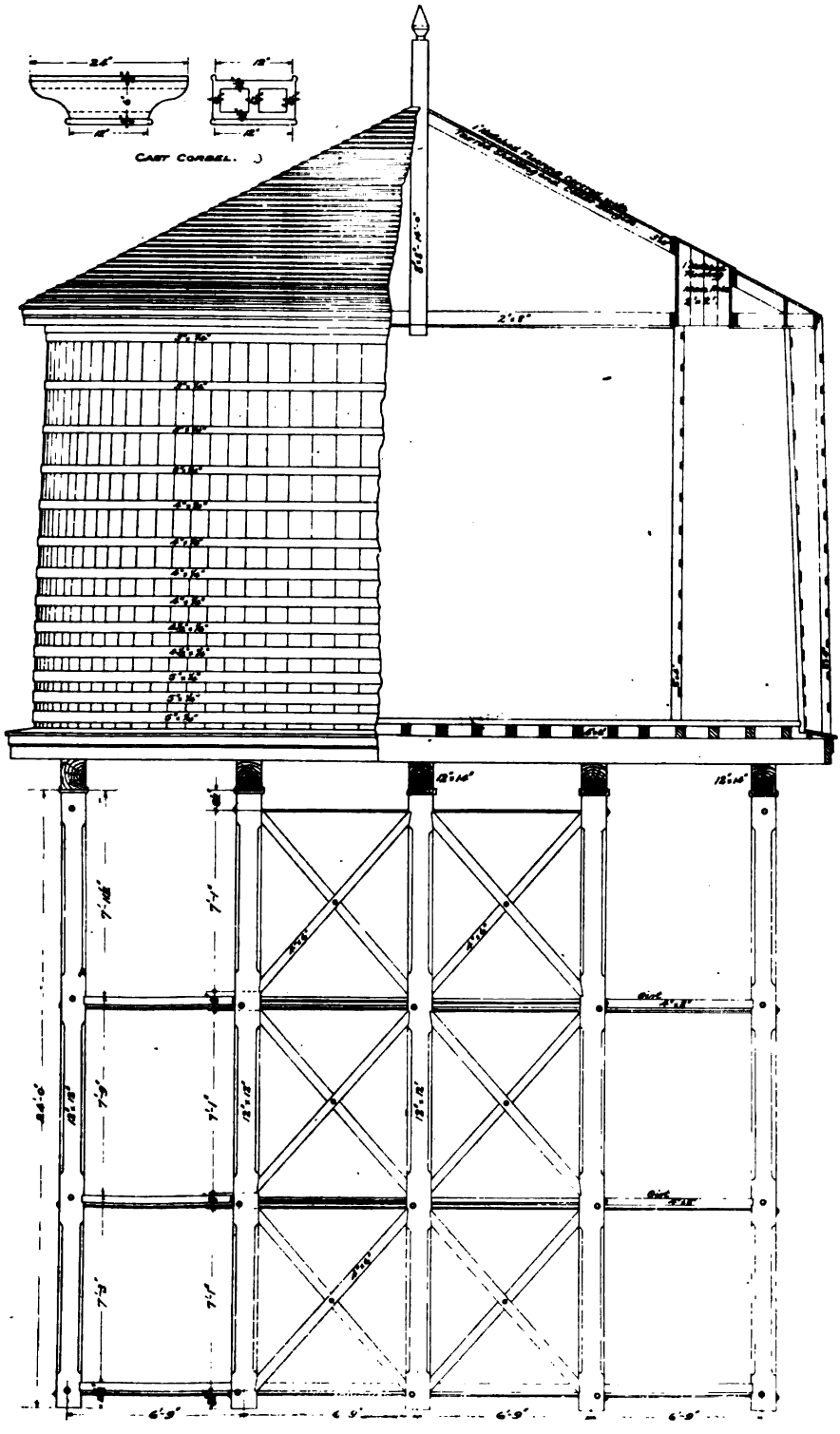


FIG. 27.—Michigan Central R. R., 16 x 30 ft. Water Tank.

standpipes through an 8-inch main, reduced at the standpipe to 6 inches. The small one draws direct from the tank through an 8-inch pipe. We have some trouble with frost under our tanks in very extreme weather, but not much, as all pipes are boxed in with double-sheathed boxes filled with sawdust and lined with paper. Our standpipe pits are 3 feet 6 inches by 5 feet inside, built of brick laid in cement, and most of them are so arranged that we can keep them filled with water to top of valve, and then they all have 2 feet of sawdust packing on top of that, and we have practically no trouble with them from frost.

1. Piers, granite at $9 per yard.
2. Wood.
4. Capacity, 50,000 and 25,000 gallons.
6. Angle with tightening bolts.
7. Double-sheathed box filled with sawdust.
8. None.
11. 6 inches.
12. 8 inches, reduced at column.
13. 13 feet.
14. Plank floor with trap.
15. None.

Following is report of W. M. Noon, superintendent bridges and buildings of the Duluth, South Shore & Atlantic R. R.:

1. Cedar piles.
2. Wood.
3. 12 feet to 30 feet.
4. 16x24 feet, capacity 50,000 gallons.
5. 12 hoops; ¼ inch x 4 to 6 inches.
6. Cast iron, with 2 ¾-inch bolts.
7. Double box 6x6, 1-foot space packed with coal braze.
8. Exhaust from steam pump is run up to outlet pipe from valve. Two-inch pipe is used. A half inch hole is tapped at outlet pipe and connection made with ¾-inch hose run over half inch nipple, and globe valve put on to shut off when not wanted. This hose is used to get rid of ice that accumulates in outlet pipe. From outlet pipe 1½-inch pipe is run up the outside of tub and down through roof near valve rod in tank, but not in the water. This gets rid of the float ice every time the tank is pumped, except where water is exceptionally bad for making ice.

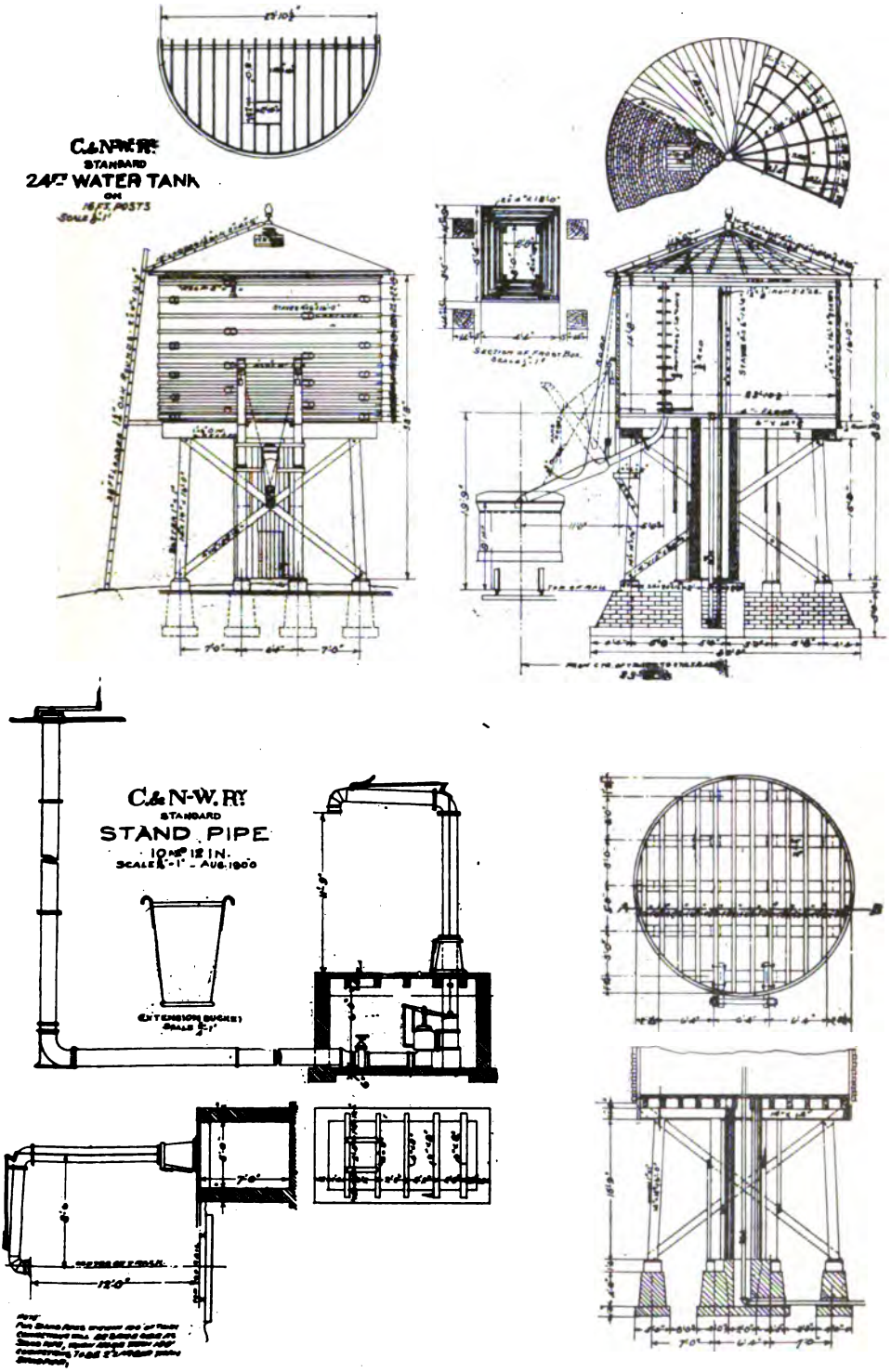


FIG. 28.—Chicago & North Western Ry., Standard 24 ft. Water Tank and Stand Pipe.

Another way is by sending exhaust steam from pump into suction pipe of pump, taking the chill from water. To do this, use a three-way stop cock on exhaust, having one pipe exhaust out doors, the other into suction pipe of pump at elbow.

Where suction pipe is connected on to pump let pump exhaust outside until primed, then throw steam into suction. This will keep ice from forming enough to cause any trouble.

9. Delivery of water from pump into tank is made about 6 inches from top of tub. It is made this way so that pipes can be drained when not pumping by having stop cock, shut-off rod and drain pit under pump in pump house. Where water does not drain away from pit use no drain cock under pump, but put drain cock in delivery pipe under tank in frost box, and a ¾-inch pipe from boiler connected to delivery pipe at pump. In this way, at any reasonable distance, you can blow water out of delivery pipe in a very short time.

10. Standard water columns are John N. Poage's 95 to 98 8-inch column.

12. Same size as water column, 8-inch.

13. Water column outlet pipe over track is 10 feet.

14. Double cover with about one foot space between, and in winter this space is filled with coal braze.

16. Provision for washing out pump boiler is made by tapping delivery pipe from pump to tank at pump with ¾-inch pipe running from there to top of boiler, where it is connected, and up about one foot from bottom of tank another ¾-inch hole is made in delivery pipe, with stop cock and shut-off rod running to top of tub.

Following is report of A. W. Merrick, division engineer of the Chicago & Northwestern Railway Co.:

1. I have no figures with me now giving cost of our standard tanks. From memory the nearest I can come is from $1,100 to $1,200 for standard 16x24 tank on wooden posts with stone foundation. I hand you herewith four prints, three of which show our standard tank, and the other one standard standpipe. The figures and dimensions on these prints answer a large number of questions on the circular.

15. For drenching stock at water tank we use 2-inch pipe, which is set in the form of a small standpipe with curve spout at top, arranged in such a manner that it can be swung from side to side so as to reach all parts of the car. We have no detail print of this apparatus.

16. Boilers in pump houses are washed out about twice a month by the pumper.

17. At pumping plants run by gasoline engine, gasoline is stored in a metal tank set in the ground outside of the building. This tank has a capacity of 188 gallons, and is connected to engine with a small pipe.

18. Our gasoline comes from storekeeper and is shipped in barrels directly to the pump house, where it is unloaded and emptied into tank.

19. The size of the pump houses which have been built on this division up to the present time is 12x14x9. These are well built, ceiled on the inside, shingled and painted; cost $175.

20. At some pumping stations coal is stored in a bin partitioned off at one end of the pump house.

Further from A. W. Merrick:

For standard permanent water station, see plan for tank.

2. Wood.
3. 19 feet, 9 inches.
4. 16x24, 47,300 gallons.
5. See plan.
6. See plan.
7. See plan.
8. See plan.
9. See plan.
10. See plan.
11. Mansfield 10-inch.
12. 12-inch, reduced at bottom of column.
13. Have no plan.
14. Have no plan.

For remainder of questions, see letter above.

Following is report of F. E. Schall, bridge engineer of the Lehigh Valley R. R.:

This report also covers the report of Mr. Walter G. Berg, chief engineer Lehigh Valley R. R.:

1. Foundation, either stone or concrete; stool, a considerable number consist of cast, or wrought iron posts, and iron floor beams; wood posts and floor system now generally used; some of the older tanks with drop pipe attachment are carried directly on the stone foundation; tubs, wood, either white pine or cypress.

Cost of piers—For 16x24 tank, as per standard shown on attached print.

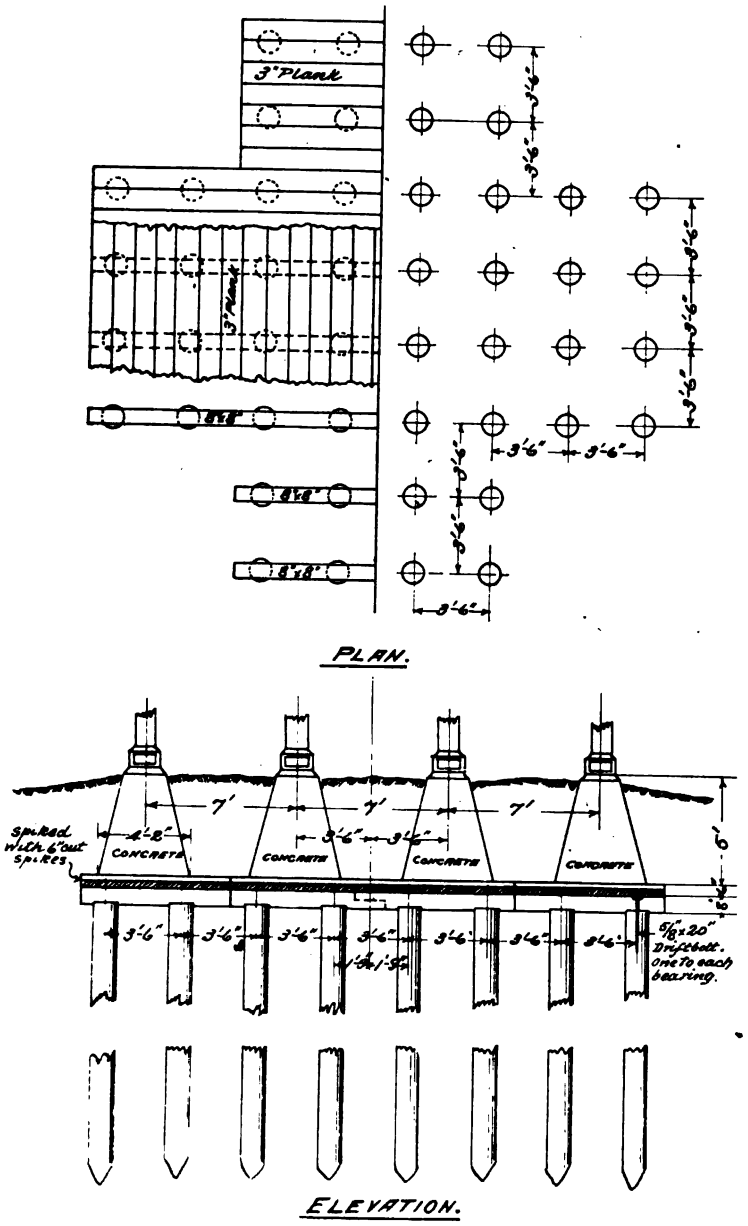
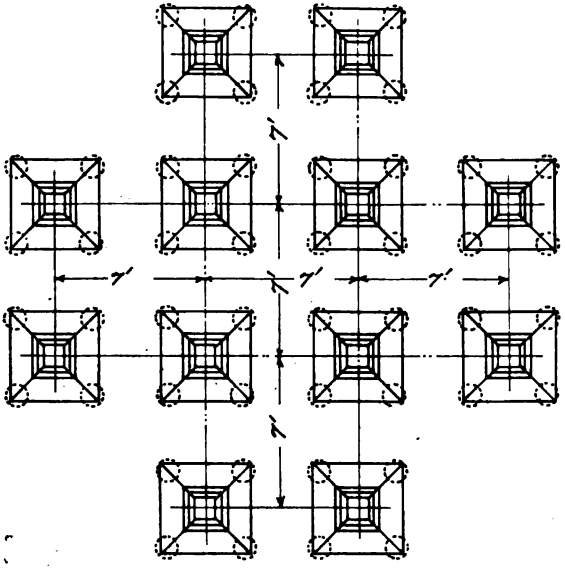


FIG. 29.—L. V. R. R., 16 x 24 ft. Water Tank.



PLAN.

NEW YORK DIV. L.V.R.R.

PLAN OF

PILE FOUNDATION

FOR

16x24' WATER TANK AT BAY AVE.

OAK ISLAND YARD.

FIG. 30.

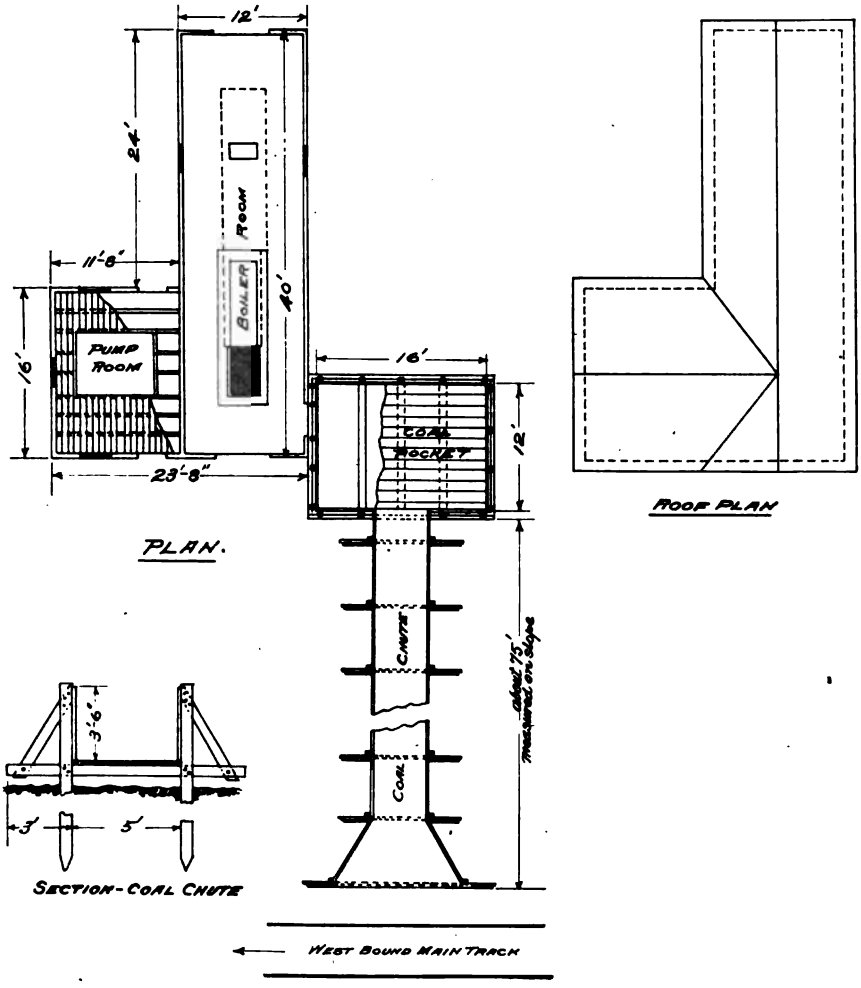
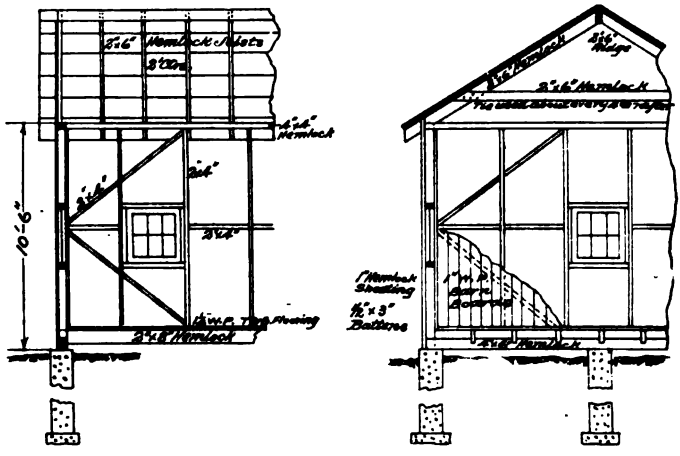
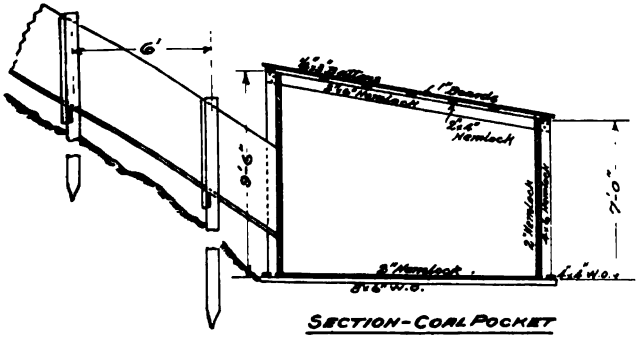


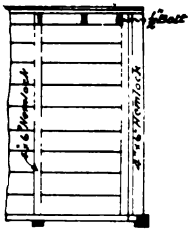
FIG. 31.—Pump House and Coal Pocket, L. V. R. R.



ELEVATIONS



SECTION-COAL POCKET



ELEVATION-COAL POCKET

FIG. 32.—Pump House and Coal Pocket, L. V. R. R.

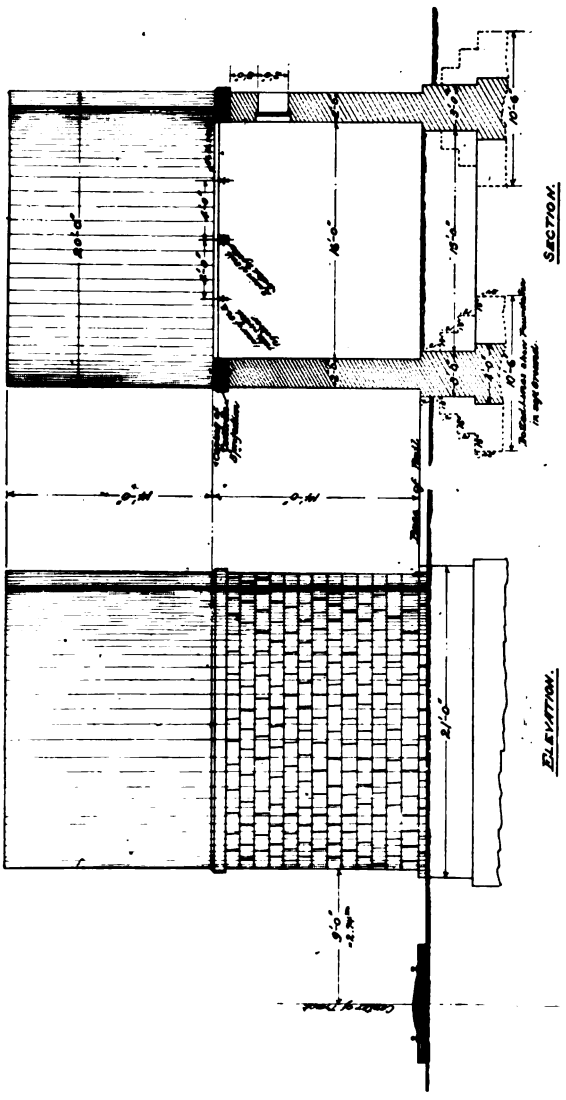
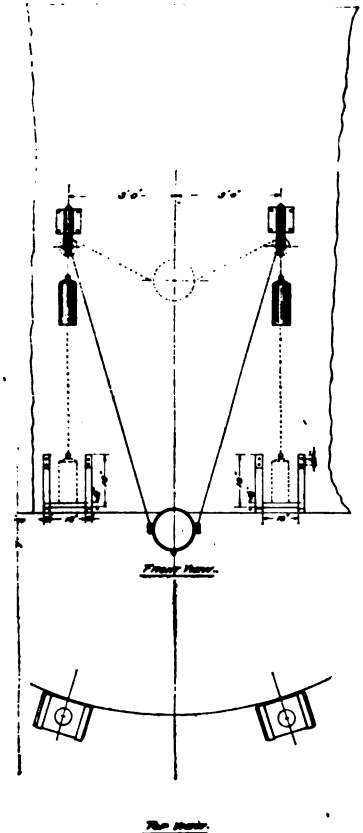


FIG. 33.—Mexican Central Ry., Support of 33,000 Gal. Water Tank.



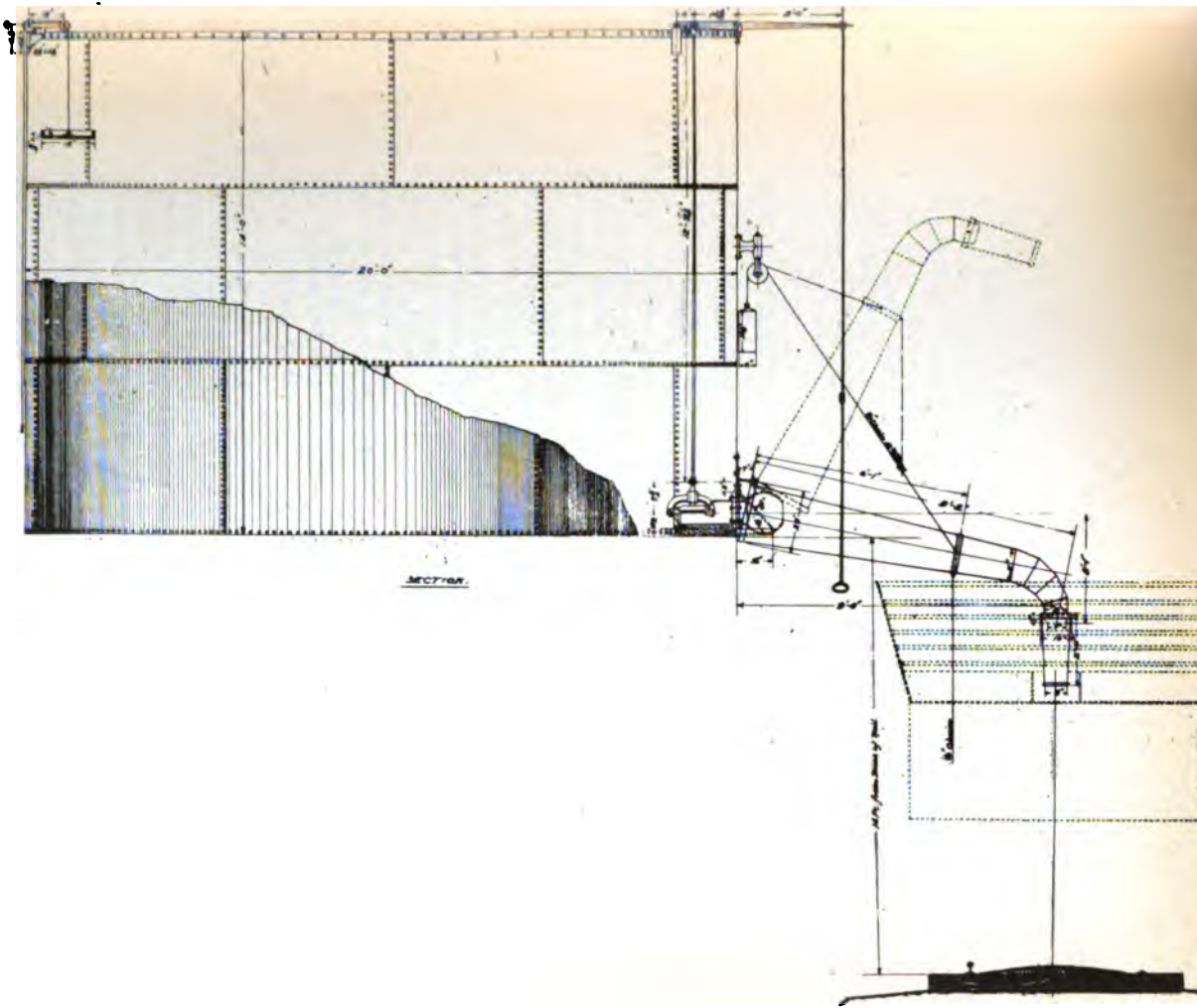


FIG. 34.—Mexican Central Ry., 33,000 Gal. Iron Water Tank.

4. See plan, 33,000 gallons.

5. None.

6. None.

7. No, sir; it does not freeze here.

17. Have but one.

20. Have a coal bin. Sometimes use wood or old ties.

For questions not answered, see plan.

Following is report of A. S. Markley, superintendent bridges and buildings of the C. & E. I. R. R.:

The Chicago & Eastern Illinois Railroad Company have adopted as their standard plan of water tank, as per blue print attached, which embodies all the details.

Standard tank, 18x30 feet and 16x24 feet, cypress, both wood and iron substructures, though the former predominates. I question the wisdom of iron substructures for wooden tanks, more particularly white pine tanks, which are short lived. A wooden substructure will, with slight repairs, last as long as a wooden tank, and both rot out at the same time. But few tanks can be abandoned or put out of service until new one is erected. Consequently a steel substructure must be in stock at all times to make renewals with to erect a new tank on. As these substructures cost about $2,000, that much money invested is always laying around and no income derived from it.

We use 10-inch Mansfield water crane, set 8 feet, 6 inches from centre of track; outlet spout 13 feet above top of rail. Standpipe connected to tank with 12-inch cast iron supply pipe, with 12-inch gate valve under tank, 6-inch Halliday valve placed in bottom of tank on opposite side from track to clean out mud, etc., from tank, with 6-inch gas pipe extending 10 feet down from tank. Bottom of tank 24 feet, 6 inches above top of rail, set on concrete piers; 8-inch concrete wall built up between four centre piers to top of same on which to build frost box, with 2 air spaces, and tarred felt on inside and outside of both spaces; double doors into frost box provided. Cast iron manhole and frame 20 inches in diameter provided in standpipe pit, which can be used at all times, while if made of wood they are always broken and out of order. No ceiling under joist of tank, or between joist and tank. Use 13 hoops, single bolt lugs. All hoops are painted before they are put on.

Pump houses for gasoline pumps are 12x14 feet, 10 feet story, brick, 12-inch wall, Ludowici Roofing Tile, concrete or brick floor, with 4 ventilators in wall to allow gas to escape. Gasoline is stored outside of building in iron tanks, made of No. 8. iron, holding from 5 to 30 barrels, depending on the capacity of the pumps. Gasoline is supplied in barrels from Standard Oil Co.'s supply.

All pumps set on concrete foundations.

Pump houses for steam plants are made of brick, 8-inch wall, 12x14 with a 12x16 addition for coal supply. Slate roof; brick stack; cost for tank and standpipe complete, $1,678.52; cost of brick pump house for gasoline pumps, $371; cost of brick pump house for steam pump, $550.

As regards turning the exhaust steam pumps into the suction pipe the subject was discussed thoroughly in our convention of 1896, and was reported in the proceedings of that convention on page 66. We still adhere to the views I expressed at that time, which are as follows:

"During the past year we have connected nearly all of our exhaust pipes from the pump into the suction pipe sixteen feet from the pump with a Y connection, the Y, of course, leading toward the pump so the force of the exhaust will aid the pump in lifting the water. We find from a number of tests made, that this increases the temperature of the water from six to eight degrees, thus preventing the water from freezing in the tanks, and saves fuel in locomotives. In putting these exhausts into the suction pipe, care should be taken that all joints are air tight, and valve stems, if any, are well packed to prevent leaking air. We have them on both duplex and single acting pumps, both of which give good satisfaction connected in this manner. In making these connections, we arrange them so the exhaust can be turned out in the open air if so desired, or into the suction pipe."

We have twenty gasoline pumping engines in operation, ranging from four to fifteen horse power. The first one installed was in April, 1897. Eleven of these are Fairbanks, seven Stickney, and two Otto. We have the best service from the combination pump and engine, all of which are on the same base. In the installation of these pumps, we can safely figure on a saving in labor of at least 60 per cent. over the steam pumps. In the majority of cases these pumps are operated either by the agent or village blacksmiths or natives who live in the villages and are employed at a cost of $10 per month. One place in particular, at Goreville, the pump is operated by a man who is seventy years of age and had never seen a pump previous to its installation, has no mechanical ideas and lived on a farm all of his life, and has been running a Fairbanks pump successfully for the past two years. This same arrangement can be applied to other makes of pumps.

We have three gasoline deep well pumps in operation, run by Fairbanks engines. These engines are located in the pump house at the surface and connected by pitman to the stuffing head at the bottom of a water-tight concrete pit ten feet in diameter and fifteen feet deep, the head being anchored to the bottom of the pit by two eyebeams laid across the pit and concreted into the wall fifteen inches in each end, all of which makes a firm and secure job. We first installed this arrange-

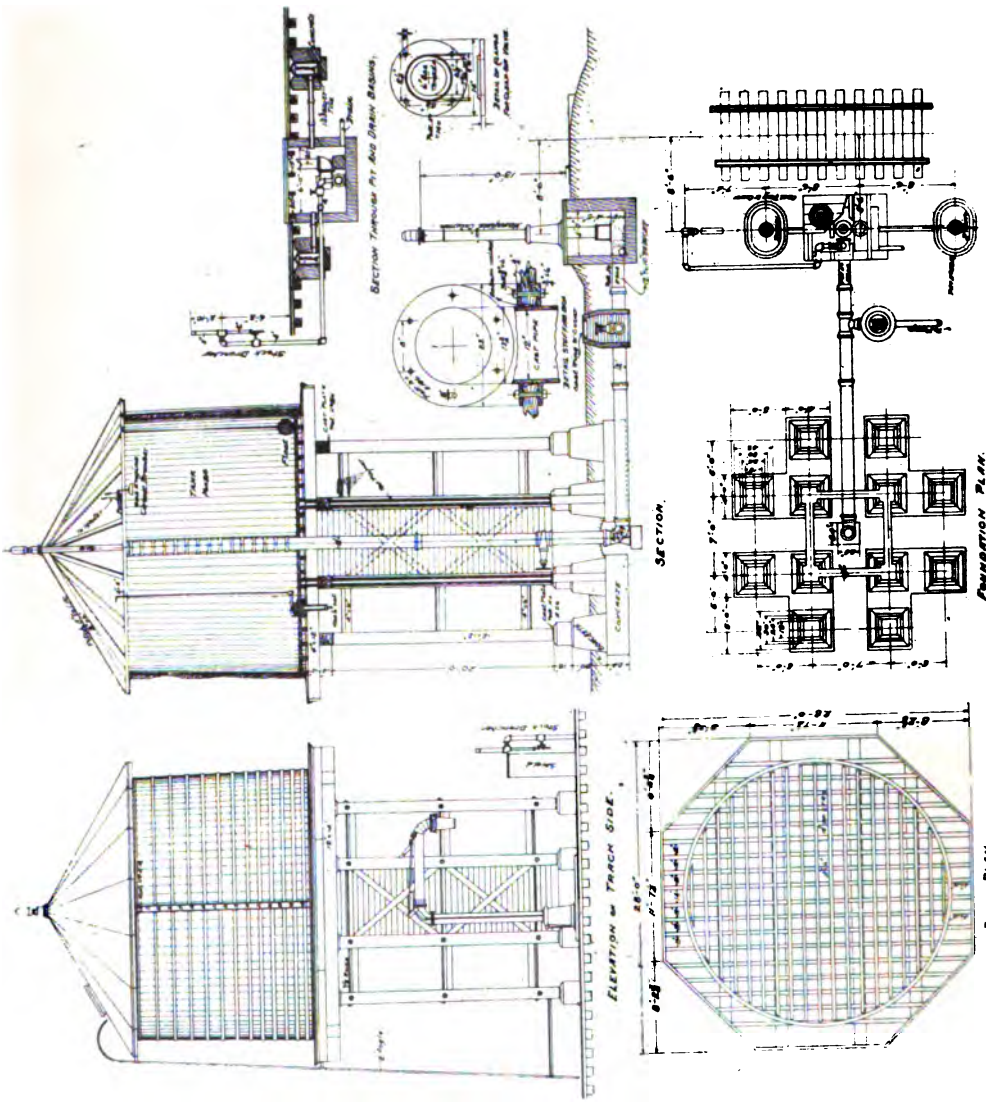


FIG. 35.—C. & E. I. R. R., Standard Water Station.

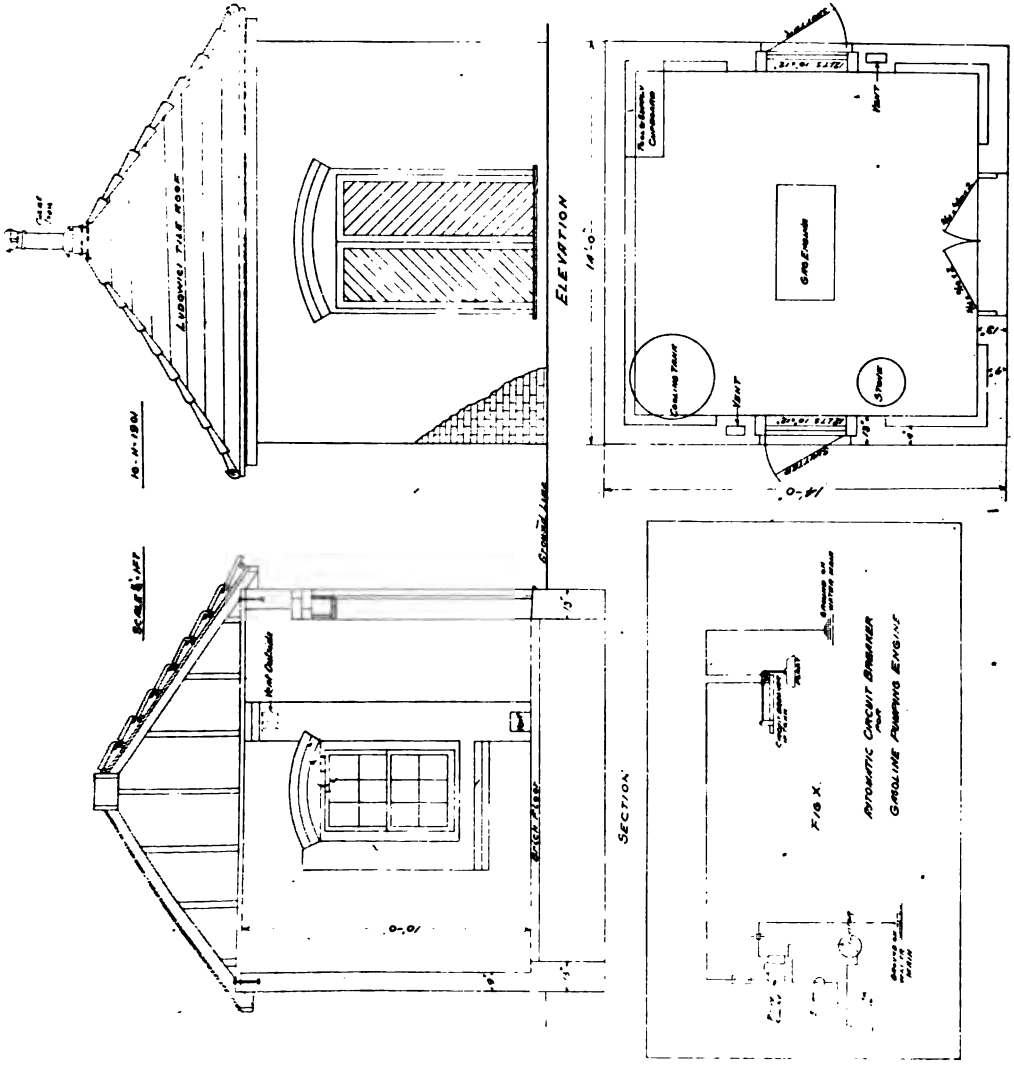


FIG. 38.—C. & E. I. R. R. Standard Pump House.

ment in connection with an eight-inch well, 116 feet deep, one year ago, which has been operated successfully by the section foreman who is in charge of the section on which the pump is located. This pump, together with twelve others, are equipped with our automatic pump stopping apparatus, which consists in :

"A circuit breaker 'A' located in tank, operated by a float so that the circuit will be closed while water is below top of water line of tank and will be opened as soon as water reaches this line.

"A 5 ohm pony telegraph relay 'B' located in pump house.

"A gravity battery 'C' consisting of one or more cells (as required, depending upon distance from water tank to pump house). The igniting circuit of the gasoline engine passes through local points of relay so that the igniting circuit will be opened as soon as water tank is filled, the engine being stopped at once. Fig 'X' shows the diagram of connections using a ground circuit for main relay circuit where the distance from the pump house to water tank is so great that it is cheaper to use one overhead wire. When this distance is only 200 or 300 feet, a complete metallic circuit is used, it being less expensive to install."

At steam plants where pumping stations are so far from tank that indicator cannot be seen, the same apparatus is used to sound an alarm in pump house when tank is full. The first pump stopping apparatus was put in service one year ago and is giving good satisfaction. With this appliance our section foreman, station agent, or village blacksmith, who are running these pumps, start them going and depend entirely on the appliance to stop the pump, which it always does.

Following is report of A. Shane, superintendent of bridges and buildings St. L. & K. C. Ry.:

"Answering your communication of Feb. 15, 1901, in regard to water stations: The material depends largely upon the locality and the means of the builder. Personally I prefer to use concrete for foundation work of all kinds, except where there is too much oil to come into contact with it; this I consider injurious. I have in one or two instances substituted vitrified brick, which I believe will do very satisfactorily. For tank foundation, stone, brick or concrete should be used, never timber. For substructure, iron or steel is preferable, though very good, durable and substantial work may be made of timber, if care is used in selecting it and specifications strong and lived up to. Standard height of bottom above the rail, 14 feet, except where the water column is supplied, there it is 28 feet. Our standard tank is 16 x 26 feet with fourteen hoops. We have never made any specifications for hoop lug. Personally I prefer double-ended bolts, threads cut right and left, with each lug tapped.

"In answer to your question No. 7: I use double precaution.

I arrange the pipe, where possible, so that it may be drained when necessary. In addition I build double frost boxes; always frame. I do not believe that a brick wall can be made absolutely frost proof. I use 2 by 6 studding, seal inside and out with rough lumber on which I lay building paper and sheathing so that I have an air chamber in the wall which is a non-conductor and thoroughly protects the interior. The frost proof box can be made any required size. I have found that where cold water was pumped into the tank it would cause a circulation of water around the tub. I have tried two or three instances this way and found it very satisfactory. Where water is taken from wells it is very rarely cold and I never thought that this method need be adopted.

"In answer to your question No. 9: 'Where is the delivery of water from pump made into the tank?' This depends largely upon the conditions; if my discharge pipe is so laid that it can be drained I prefer to go up on the outside of the tank and over the top, for the reason that a current of water can be maintained that will largely prevent the formation of ice on the top of the water. When the pipe line is long and the draining will possibly be slow, and for other reasons make it necessary to do so, I run my discharge pipe up through the bottom of the tank, always, however, carrying it above the top of the same, so the pipe line can be drained without the aid of a gate valve. The elevation of the outlet spout above the rail depends, of course, upon the height of the engine tank. Our standard is 10 feet. Our water column is 8-inch, except that we have one 10-inch in service which is very satisfactory. I never make the water supply pipe to water column larger than column except on long lines. I have, in one or two instances, where the water supply came direct from the water-works, been compelled to reduce right at the column. Elevation of water column outlet spout, above the rail 10 feet. I use common hatch doubled to cover manhole. I have a standard stock drencher the tracing of which I enclose herewith.

"Answering your question No. 17: I will answer in a general way later, also No. 18. My standard pump house is 16 by 16 feet, 14-foot walls for steam, and 10 by 12 for gasoline. Build coal house 10 by 30 at all steam water stations. I call your attention especially to the plan of water station recently constructed at Bingham, Ill., provided with a gasoline engine, which is proving very satisfactory. The agent takes entire care of this plant. His office is one half mile from the pump house. The elevation of the tank above the pump house is 60 feet, from pump house to well 20 feet. The funnel for emptying gasoline into the gasoline storage tanks is 30 feet above the tank house, it being at the grade of the track. I do not think it necessary to dwell at any great length upon this plant, as we are familiar as to how such stations are handled. The only particular advantage which I claim in this plan is that the gasoline is never exposed to any danger after it is put in the funnel at the grade

of the track, it being conveyed into the storage tank and to supply tank by the pipe lines so that the greatest degree of safety is secured, never having occasion to handle it at all. The gasoline house, you will observe, is perfectly fire proof, being built of vitrified brick and covered with galvanized iron. It is first sheathed, upon which is laid a layer of tar paper, and sheathed again, over which the galvanized iron is nailed. The plant has been in service for five months and has not had a minute's attention from any one except the agent."

The committee desires authority from the Association to have all the blue prints, that is, the general plan of them, lithographed and made a part of this report. They are some twelve or fifteen in number. No two of them are alike. The object in asking this of the Convention is that all the different make-ups of water tank that are known, almost, are embraced in these blue prints, and are much easier understood and explained in the prints themselves than any one can write them up, and members will have a better understanding of them from the prints than they will have from a mere description of the plants themselves. If the Convention will allow this to be done, the committee will have tracings made of them so that the lithographs can be made, and should not be made smaller than half size, which would be, when completed, about ¼-inch scale. Of course, by this, the committee does not propose to print all the details where they are on several sheets, but where they are embodied on one sheet, the entire plan can be reproduced with good results, but where they are on several sheets and a general plan is furnished, the committee doubts the wisdom of making a lithograph of the various sheets. However, that is a matter that can be decided by the Convention, if it so elects to have them, including the details, reproduced in the proceedings. To have the blue prints traced, as they must be before they can be lithographed, will cost in the neighborhood of $35 or $40, which I believe will be well worth the money to the Association, as well as additional value to the proceedings.

Special efforts have been made by the committee on this subject to get special information in reference to the use of iron for water tanks. Researches were made embracing almost every state in the Union for information in this direction. The information gained through these researches has been very favorable, and leads the committee to believe that the time is not far distant when nothing but steel or iron water tanks, and their substructures, will be in general use on the majority of roads; and a great deal of stress has been laid heretofore, and a great deal of argument produced, as to how these tanks should be painted on the inside and at the same time keep them in service. This, we all know, is an impossibility, and cannot be accomplished. The use of paint on the inside of a tank, where it is at all times kept filled with water, is useless, and we believe that no good results would follow if it were possible to

keep it painted. As an example, we can only refer to the locomotive tanks which are constantly in use and are never painted on the inside. No doubt any of us can call to mind locomotive tanks that have been in service thirty or forty years and are in a good state of preservation so far as rust from the inside is concerned. Researches in this direction by the committee have been made, and we believe can prove the above assertion made. The use of wood for water tanks is fast becoming short lived. It is true wooden tanks are still standing that were put up in 1880 and are good yet for two or three years, yet on the other hand tanks that were put up in 1886 and 1888 must be renewed in the next two or three years. This is attributed to the defective white pine timber that is being used for structures of this kind. While the use of cypress is longer lived than white pine, yet it will be but a short time before this timber will be exhausted and the use of iron will have to be substituted. The committee tried on several occasions to get information in reference to fir timber for this class of work, but no information could be had in that direction.

Mr. C. F. Sharpe, bridge engineer of the Denver & Rio Grande Railroad, writes, under date of May 15, that he has no iron water tanks but has used 16x24 red-wood tanks, which will last for twenty years and possibly more.

Three members have expressed themselves in reference to the use of iron.

Mr. H. D. Cleveland, superintendent of bridges and buildings of the Pittsburg, Bessemer & Lake Erie R. R. Co., writes as follows:

"Replying to your letter of May 29 relative to steel water tanks, would say that I have put up three steel tanks 21 ft. x 21 ft., and they have been in service three years. I have never experienced any trouble in their freezing up. The only objection I could have to them is the trouble of painting them on the inside, as we have to let them dry before painting, and, of course, after painting, we find it hard to throw the tank out of service long enough to do this, and are liable to let it go longer than we ought to. They make a very neat-looking tank with an iron substructure, and I think a very durable tank if they are kept painted."

Mr. James Brady, superintendent of bridges and buildings, Chicago, Rock Island & Pacific Ry., under date of July 26, writes as follows:

"I have two of these tanks on my division, size 20 ft. x 60 ft., capacity 140,000 gallons. I erected both of these with my own men. The cost of labor for erecting was $379.60 each. These tanks are set on concrete foundations. They are located at our large water stations where there is always a good circulation, and we have no trouble from water freezing in them in the cold-

est weather. These tanks have been in use for three years, and with the experience I have had with them so far I consider them the best tank. The total cost per tank at time of erection was $2,232.40, but the iron market was pretty low at that time."

There are some objections given to the use of water towers, none of which, as the committee sees, can in any way interfere with the use of them in any climate. The objections raised are, that the water freezing in the tower when the tower is nearly full of water, the core of ice becoming loose from the tower and the water being drawn from it, the core hanging to the side of the tower and the weather moderating, allowing it to thaw loose, it is liable to fall and damage the tower.

The committee has noticed one occasion where the ice has extended some eight or ten feet above the top of the tower. This can be overcome and prevented by riveting cross stays in the tower, which will prevent the ice from raising or lowering with the water.

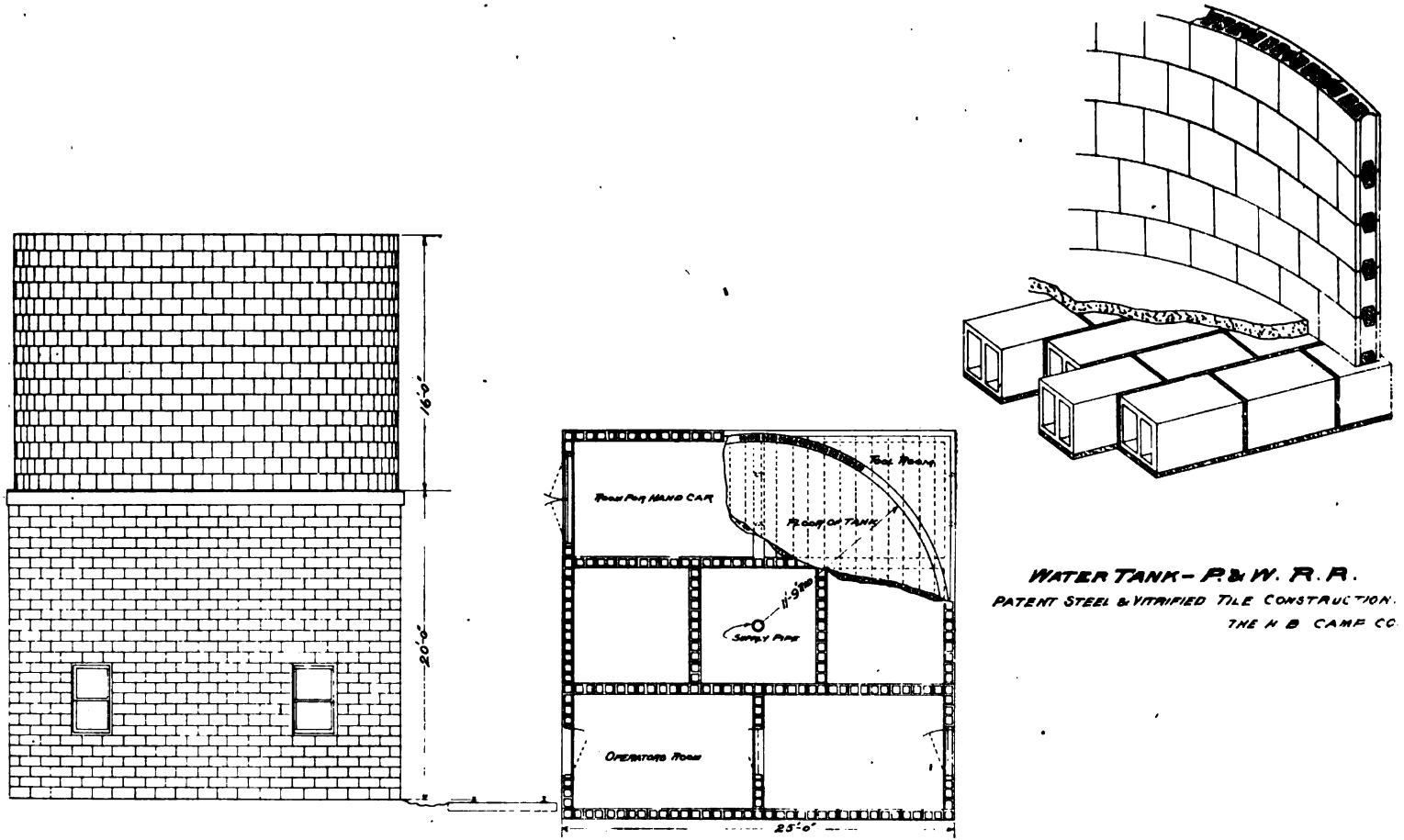
The Chicago Bridge & Iron Works, in 1899, erected a steel tank, 20 feet in diameter, supported on four steel legs, for the Chicago & Eastern Illinois Railroad Co., at Thebes, Ill. This is the first tank of this kind they have erected up to this time, on any railroad. The tank so far has given perfect satisfaction in every particular and I believe it is only a forerunner of its adoption by other roads.

The H. B. Camp Co., of Akron, Ohio, erected for the Pittsburg & Western Railroad, at Hazelton, Ohio, one of their tile tanks. The attached letter from the H. B. Camp Co. fully explains the history of this tank. Also a letter from Mr. Paul Didier, chief engineer of the Pittsburg & Western Railroad, as well as remarks made by Mr. William M. Clark, superintendent of bridges and buildings, of the Pittsburg & Western Railroad. The explanation of this tank can only be illustrated by the drawing itself.

Following is the letter from H. B. Camp Co., dated March 27:

"We send you blue print of water tank built by us for the Pittsburg & Western Ry., at Hazelton, O. The tank has been standing two years, but the first winter they did not get the pump ready so it was not filled until last summer. There was a slight leakage and we made the request that they draw the water off and give us a chance to make it tight, but they replied by saying that the leakage was so slight, and they needed the use of the tank, and would not give us a chance to remedy the defect. We have heard nothing from it this winter but suppose it to be all right.

"About fifteen years ago I put in a penstock at Cuyahoga Falls for 150 horse power water-wheel, on pretty much the same construction. It was 10 feet in diameter and 18 feet deep. It


WATER TANK - P. & W. R. R.
PATENT STEEL & VITRIFIED TILE CONSTRUCTION.
THE N B CAMP CO.
Pump Room
Pump Room
Pump Room

stood on six columns of 12-inch sewer pipe. Immediately on top of the sewer pipe was a casting full size of the tank, with a hole in the centre for the draft tube for water-wheel. We did not get a good foundation for those supports and one after the other came out. We substituted a casting, putting the foot into a drilled hole in the blue shale. During the process of substituting the foundation there was a slight settlement that caused a crack about the point where the flume joined it. Of course it leaked there slightly but I was at the tank only last week and it was just as it had been all this time. Had it been of wood it would have had to be renewed about twice, but to all appearance it is good for a thousand years.

"From our experience with the Youngstown tank it seems to me, aside from the material that the tank is made of, it would be a decided improvement to make this a continuous tank from the ground up, with both out-take and intake coming in the water, then have a swivel joint on the outlet and its height controlled by a float on the water so that in use it always uses the water from the top. And with the intake pipe arranged so as to produce as little agitation as possible, then the bottom of the tank would contain the settlings. Perhaps it would be possible to treat this water chemically. At all events, under such conditions as prevail near Youngstown it would avoid running large quantities of silts into the boiler. We have personally had such serious trouble with our boilers that where it seems so easy to overcome it largely, it is almost a crime not to take advantage of it. The cost of such a tank would be but little more than such construction as we put up at Hazelton.

"Any questions you wish to ask we would be pleased to answer if it lies in our power."

Following is a letter from Mr. Paul Didier, under date of April 2, 1901 :

"The tile tank has withstood the very heavy frosts this winter, no roof has been put on the tank, to give it the best show and severest trial, but must say that it behaved itself over and over the most sanguine expectations and cannot but recommend it. This is the first tile tank of this nature. If there is any mischief to be done it can be done just as well with a wooden tank as with a tile, and that has been the universal objection of most of the people, thinking that fellows can come around and break a hole through the tile; it can be done, but it is not such an easy matter."

A. S. Markley,
Chas. Carr,
W. O. Eggleston,
A. J. Austin,
A. Shane,
Committee.

DISCUSSION.

Mr. Markley (A. S.).—My report covers that pretty thoroughly, with the exception of a table that I did not include in the report. It is a test made in reference to the cost of screenings, lump coal, and gasoline in pumping water, and in making this test I feel as though we have a very accurate report on which to base the cost of pumping water per one thousand gallons, with gasoline or coal. (See table "C. & E. I. R. R., test of cost of fuel for water stations.")

Mr. Berg.—I think there are two features in the report to be discussed, one is the economy or desirability of using iron tanks, and the other is the desirability of and success obtained with the tile tank, that we have heard a good deal of for about two years now. I think it is always interesting to keep it in mind and learn more of that special class of construction. The iron tank is certainly a live question and one that we should take up pretty thoroughly. It seems to me in discussing iron tanks, the first question to settle is, whether the water tower feature is a desirable one, bringing the tank right down on the concrete foundation, and having a certain amount of dead water in the bottom of the tank, or whether the iron tank should be built, as is customary, with a wooden tank on an iron substructure.

Then a question of detail is one whether the iron tank should be painted on the interior, and whether the question of frost and freezing action is a damage to the tank.

Mr. Carr.—The question of iron tanks has been discussed pro and con between parties at different times and I took little interest in it, and believe at first the general opinion was the iron tank was not the best tank to use on account of ice forming, etc., but I am inclined to think that the opinion in regard to the practical use of the iron tank has changed somewhat. As to the question of painting a tank inside, I do not think it would be practicable to do that, and I don't know that the iron tank would suffer very greatly even if not painted on the inside, don't think it would. Would depend a great deal on the kind of water put in the tank, and as to the freezing, I see in the report on the water question a statement there that the ice had formed and raised above the tank some eight or ten feet, and I would like to inquire how

C. & E. I. R. R.

TEST FOR COST OF FUEL FOR WATER STATIONS.

Name of Station.	Date of Test.	Pounds of Coal Used.	Kind of Coal.	Price of Coal.	Cost of Coal.	Gallons of Water Pumped.	Cost per 1,000 Gallons.
Winthrop, Ind.....	Sept. 27 to Oct. 7, 1901.	1,470	Mine run.	90c. per ton.	$0.66[18]	125,093	$0.00[52]
Oxford, Ind...	Oct. 1 to Oct. 8, 1901.	760	Pick up from coal chutes.	40c. per ton.	0.15[20]	47,625	0.00[32]
Clinton, Ind.....	March 28 to April 3, 1899.	8,425	Screened coal.	67c. per ton.	2.82	343,900	0.00[82]

Record of Cost of Gasoline and Battery for Tamms, Ill., Water Station, Covering a Period of Eight Months, Including all Leakage, Waste, and Evaporation.

	Gasoline Used, Gallons.	Price of Gasoline.	Cost of Gasoline Used.	Number of Recharges for Battery.	Cost of Recharges.	Number of Gallons of Water Pumped.	Cost per 1,000 Gallons.
	615	$0.10	$61.50	6 Edison Type "R."	$7.56	4,836,000	$0.01[43]

From record of tests made in 1899 for cost of gasoline only per 1,000 gallons of water pumped.....	Bourbon.....	0.01[07]
	Clinton.....	0.00[88]
	Wellington.....	0.01[04]

much water that tank holds? I hardly understand the situation. I would further state that it is my opinion that something certainly has got to be substituted for the wooden tank. The timber and lumber that the tanks are made of is getting too scarce to be used economically, and I believe the iron tank is the coming tank. And another question, while not a great many probably are interested in it, is the track tank, and if any gentlemen here have had any experience with the track tank, I would like to have an expression as to the best way of caring for them, treating them, etc., if they will enlighten me on it.

Mr. Markley (A. S.).—Mr. President, I would like to say that Mr. Carr signed that report on water stations with the greatest of confidence. Now he doubts the report. The tank referred to in the report, where the ice extended some eight or ten feet above the top of same, is a stand-pipe 125 feet high and twelve feet in diameter.

Mr. Clark.—Speaking about iron tanks and the life of tanks, we put in service an iron tank that had been used for oil twenty-two years, and any person that knows anything about the oil business, knows that there is a certain amount of salt water that is at the bottom of the tank at all times, and we all know that salt water is very hard on iron. This had been used twenty-two years for oil and we used it twelve years for water before it gave out; that makes the life, without any paint on the inside, thirty-four years. The salt water being in it probably would deteriorate at least five or six years of the life of the tank, so that my idea of an iron tank would be that it would be good for thirty-five or forty years.

Mr. Lichty.—Would like to say some waters are very much harder on iron than others. We have water that will eat through iron pipe in from four to five years, nearly quarter of an inch. Of course water like that would be much harder on an iron tank than water used by a great many other roads where it is of a better quality.

Mr. Markley (A. S.).—I would like to ask if you use that water in the engines?

Mr. Lichty.—Yes, sir, and they have to renew parts of the fire box in from six to seven months.

Mr. Clark.—I would say that I would not warrant iron to last

forty years with all kinds of water, and I was speaking about water, not about something that was mixed with other ingredients that eat up the iron.

Mr. Cummin.—I agree with Mr. Clark that it depends a great deal on the water and do n't think where you have got water that is fit to be used that it is necessary to paint the tanks on the inside. A number of the villages on the Long Island are supplied by the stand-pipe system. Some of those stand-pipes have been up a great many years that I know of and not one of them has ever been painted on the inside of the stand-pipe, and they are in first-class working condition to-day, and it seems to me that that argument against iron or steel tanks will not hold good where the water is fit to be used.

Mr. Carr.—Speaking of iron as used in tanks : in Michigan we have, or are supposed to have, pretty good water, surface water for our engine purposes, and are using track tanks ; use three-sixteenths inch steel, and if one of those tanks will last four years without having to be patched, we call it a pretty good tank, and so far as the water for the engine purposes is concerned, it is as good as any surface water you get out of ordinary creeks or rivers flowing through the country ; we call it good water.

Mr. Canty.—On the division where I am located we have a good many small iron tanks, running in capacity from ten to twenty thousand gallons. Do not know definitely how long these tanks have been used but would say from fifteen to twenty years. On account of changes at a few points some of these tanks were discontinued several years ago. The tanks were stored in our yard and were not protected in any way. Had an opportunity during the past year to use several of these and found them practically as good as new. About gasoline pumping outfits, we had one which was run night and day. It broke down so often that we were continually in trouble. Our men claimed it was overworked and needed rest, but as the place where this was located is one of the most important water stations on the division we had to have something which could be depended upon. We hesitated about taking out the gasoline affair but finally installed a steam pump. If any of the members have gasoline outfits which are worked day and night I would like to know if they have any trouble with them.

President.—I had occasion to use a gasoline engine where it had to be run day and night, and it became necessary to change the battery, using one during the day and one at night. This might possibly have been the cause of your trouble.

Mr. Lichty.—The Chicago & North Western road used two types of gasoline engines, and finally came to the conclusion that the Otto gas engine was the best they could get, and I believe all the pumping plants now are of the Otto gas engine make, and they work very successfully. In regard to working day and night, I hardly think we ever had any kept running as long a time as that constantly.

Mr. Killam.—In reference to iron tanks, I do n't know as I can give much information. We do n't have any of them on the Intercolonial System. Our tanks are made of pine, the staves are four inches thick, some sixteen feet high, capacity fifty to eighty thousand gallons and set some seventeen feet above the rail, and they are roofed over, round top. We do n't have much trouble with the frost, as it is not so very cold (?), seldom gets lower than twenty-five degrees below zero; but we put a cast-iron column up through the centre of the tank; through that runs a stovepipe, which keeps the water quite warm enough. I was a little amused in regard to some of those iron tanks spoken of that were eaten out in three or four years by the bad water; I wondered what became of the locomotives they used that water in; how long they stood.

Mr. Cummin.—In connection with the report of this committee, I noticed one thing in the questions sent out, and I think it would be wise to remember when sending out questions to make them as plain as possible. It shows some of the inconsistencies of the English language. I got hold of the questions and one of the questions was, "What is the size of the lead pipe leading from the tank to the water column?" I shook my head over it and finally arrived at the proper conclusion, but I notice in the replies received, one of the answers to this question was, "Do n't use any lead pipe, use cast-iron pipe." But both of the words used are spelled the same way, and therefore we should endeavor to make those things as plain as possible.

Mr. Clark.—I might say in regard to our tile tank, that it is a perfect success so far. We have been carrying water in it about

a year now, and have had no trouble with it. Have not spent a cent on it, and to all appearances it is all right. No tile broken.

Mr. Cummin.—What size and cost?

Mr. Clark.—The capacity is 100,000 gallons, but the actual cost I cannot give you, as it was put up for our people as an experiment. We paid the same for it that a wooden tank of the same capacity would cost. We were to furnish the foundations free and we drove eighty-one piles for the foundation of this tank.

Mr. Cummin.—It seems to me it would be a pretty expensive tank, if you have got to drive eighty-one piles.

Mr. Clark.—As I said before, it was an experiment, and we wanted to do our part right. It was in a very soft spot where there was no bottom or foundation, and it was necessary to drive that number of piles to hold it up.

President.—The question of foundation should not enter into the cost of this particular kind of tank, as it might be necessary to build the same kind of a foundation for any tank.

Mr. Clark.—We would have had to put in the same kind of a foundation for a wooden tank.

VII.—Is it Best for Railroad Companies to Erect their own Steel Structures or let the Manufacturers Erect them?

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Pursuant to the investigation of this subject your Committee endeavored to embody in their circular a line of questions that would be most likely to bring out the points essential to a satisfactory discussion and report on this important subject. While deploring the fact that only two fifths of these circulars brought forth a response, we still think we have obtained important data.

It is evident that but few railroad companies erect all of their steel structures. Some companies erect only minor structures such as plate girders, leaving all heavy pin connected or riveted spans for the manufacturers to erect.

Traffic is maintained during erection by all, whether erection is done by company forces or by manufacturers, but it is conceded that traffic is very much better cared for by the companies' forces. There is additional expense incurred in nearly

all cases where erection is done by the manufacturers because of the companies' forces being obliged to care for the falsework. It appears to be almost a universal custom where erection is let to the manufacturers that the railroad company furnish, put in and maintain falsework, maintenance officials not wishing to trust the maintenance of such structures to any but their own experienced men. Transportation officials offer even more serious objections because of the greater delays to their trains. It seems to be an uncontrovertible fact, arrived at by long experience, that this feature of the business is very much better taken care of by the railroad companies' men than by the manufacturers' men. A good reason for this lies in the fact of the railroad companies' men taking a greater interest in the work of maintaining traffic without serious delay than can be reasonably expected from a contractor's men, both being desirous of promoting the welfare of their respective employers and getting as great an amount of work done in a given time as possible. It would be no great wonder if the contractor should close his eyes to an infraction of a rule of the railroad company that would put dollars in his pocket. Those of you who have worked for contractors on this kind of work will understand how it is. That the railroad companies' men are on the work caring for traffic and the maintenance of the falsework, etc, your Committee take it, is the reason that nearly all agree that traffic is generally well maintained during erection. In some cases where structures are let to the manufacturers there is a penalty provided for in the contract designed to prevent serious delay to traffic, but it is generally a dead letter; even if such delays occur, unless of the most flagrant character, the contractor most always manages to get out from under in one way or another. Railroad officials seem loath to exact the "pound of flesh" even when it has been clearly forfeited. The cost of erection varies greatly, and this condition is brought about from the fact that contracts when let embody various conditions. In some cases the railroad company furnishes materials, puts in and maintains falsework, frames and puts on ties and guard rails, leaving the manufacturers to furnish and erect the steel only. In isolated cases the manufacturers are allowed to bid a lump sum for the bridge in place, they furnishing all materials for falsework and erection. In either case the complications are such as to render the exact cost of the erection a difficult problem. The same difficulty is experienced by company forces because of the manner in which accounts are kept. When a structure is selected for renewal an account is opened with that structure as soon as the first work is done, no discrimination being made as to falsework or removal of the old structure and putting in the new. In making comparisons between the cost when erected by contractors or if erected by the railroad company, this manner of keeping accounts precludes any possibility of a fair comparison. This, we think,

accounts for the varied costs reported by different members, as well as the seemingly impossible low figures which such erection is said to cost. The manufacturers can, of course, erect such structures at a very much lower figure if structures are located close to their plants than if they are compelled to send men from the mills to great distances. This condition does not, however, apply with as much force as formerly, for the reason that manufacturers have men distributed (or can obtain competent men) in all parts of the country, so the expense is really no greater for transportation in one section than in another. The cost of erection has been given when done by manufacturers variously at from $3.50 per ton to $40 per ton. When same work is done by railroad company forces it is said to cost from $5 per ton to $20 per ton. Taking these figures for a basis it would seem to be very much cheaper for erection of these structures to be done by the railroad companies.

In pursuance of information it is interesting to note the evident lack of uniformity in handling this class of work. One road reports that contractors are not used on their lines at all for any purpose, everything is done by railroad company's forces; one other company does all its own iron and steel erection, but in other lines of bridge work contractors are employed. Both of these roads are among the largest in the country. Another large road does all its own erection, but considers if a great amount of work was to be done it would be cheaper to allow the manufacturers to erect them, while another equally large road considers it best to erect its own steel if a large quantity is to be erected, which would justify procuring the necessary erection tools.

Great stress is put upon the necessity for special tools for erection of steel structures. While it is a fact that special tools are required for this purpose, many of these appliances can be used to good advantage and with economical results for other purposes when not in use for erection. On some railroads it has become a recognized fact that when any difficult job is to be accomplished it must be relegated to the Bridge Department to do. If proper erection appliances are a part of the Bridge Department equipment, these special jobs are accomplished with dexterity and despatch, and with economy to other departments involved and with credit to the Bridge Department. It also tends to make it comparatively easy to obtain such appliances when needed.

The method of handling erection has been touched upon by some of our correspondents. This feature, while possibly germain to the subject under investigation, can be best brought out in the discussion of the subject on the convention floor.

Your Committee is of opinion that all bridge work can best be done by the forces of the railroad company. Such tools and equipment as are necessary for erection of steel bridges should be a part of the equipment of all bridge and building depart-

ments, and men should be educated in their use, in consequence of having to maintain such structures after erection. A bridge force should be competent to do all kinds of bridge work, and the usual repair force should be available as a nucleus for a larger force for erection purposes, should occasion require. It would certainly be far more satisfactory to the railroad company as well as the head of the Bridge Department, if when important work was proposed on the line, it was not necessary to go outside for some one to do that important work.

In conclusion your Committee is convinced it is best for railroad companies to erect their own steel structures. In most cases where such structures are given over to the manufacturers to erect, the railroad company's forces are required to do all the hard, expensive work; viz.:—putting in and maintaining falsework, taking out old structures, and finally making a general cleaning up, leaving the cream of the job for the manufacturers' gang.

(Signed) O. J. Travis,
F. S. Edinger,
A. B. Manning,
Jas. McIntyre,
A. Zimmerman,
Committee Subject No. 7.

DISCUSSION.

Mr. Zimmerman.—The report of this committee by Chairman O. J. Travis has been read to the members of this convention by Mr. Pickering, the assistant secretary. I cannot, at this time, add anything of special interest. As I consider this a very important subject, I would be very much pleased to hear from each of the members, and especially from those who have been handling this class of work.

Mr. McIntyre.—I do not know that I have much to offer in addition to the report, except to emphasize the importance of railroads erecting their own bridges. Railroad managers should insist upon having their own men put up their bridges. Competent bridge men can do the work cheaper and better. I know personally whereof I speak. A contractor's profit derived from the erection of a few 150 foot spans will more than pay for the equipment of a bridge gang.

Mr. Riney.—I erect a good many bridges; have seen a good many erected by others. I cannot fully agree with the report,

that it is best for railroad companies to erect their own steel structures, for as a general rule the railroad company's forces are not properly equipped and prepared to handle the work so as to compare favorably with the contractor for that reason. The contractor has a crew of organized men traveling over the different roads properly equipped in their line, whereas the railroad companies depend on the different divisions to handle their work. They have old men who have possibly five or six bridges to erect in a season, over that mostly repairs, and it is out of their line. The prices given in this report I do not think will hold good. Another thing, where the railroad companies attempt to do their own work, the bridge crew lives probably from seventy-five to three hundred miles from home, quit at nine o'clock Saturday morning to go home for Sunday, return at noon Monday or in the afternoon, and their time is given them while away; while the contractor, with his men, makes his home wherever his work is; gets a boarding place for his men at the nearest place that he can to the structure, and instead of the work being on the company's hands three weeks, with the company's men, it is on their hands with the contractor possibly ten days, the same style of work, and when it comes to dollars and cents, I think the contractor is the cheapest man to handle the work.

Mr. Staten.—Answering the question of contractors being on the company's hands ten days, I would say that our experience has been entirely different, as we have suffered a good deal from delays from contractors; especially, one to whom we paid for the work at the rate of $18 per ton for a quick job, so as not to have a slow order out any longer than possible. We could do the same work with our own force for $9 to $12 per ton.

President.—You were unfortunate in the choice of your contractor.

Mr. Staten.—One of the best companies in the country, and supposed to have the best men.

Mr. Berg.—I think the conclusion reached by the committee, namely, that the erection work can best be done by the forces of the railroad company, is theoretically correct, but I also think the report should have given more attention to the feature that it is not every railroad that has enough work on hand, not only for one or two seasons, but for a long time in the future, to warrant their

organizing a first-class gang of bridgemen, and getting the proper tools, and also getting a good bridge erecter as foreman.

Mr. Markley (A. S.).—Would like to hear from Mr. Stannard. I think he does most of his own work.

Mr. Stannard.—I would say relative to railroad company erecting their own iron bridges, that we do all our erecting, both in pin connections and girders. In my judgment the railroad company can do such work much cheaper than the contractor; as while they are obliged to put in their own false work and change track the same men can do the erecting. In my experience this is the cheapest and best way for handling this class of work.

Mr. Clark.—With us it has become a matter of dollars and cents. We are now paying contractors forty cents per hour for the men and paying fifty-five and sixty cents for foreman, then twenty-five per cent. additional for supervision and use of tools. We can do the work cheaper ourselves by putting on a foreman at $100 per month, and paying less for labor. You cannot get a good foreman who understands iron repair work for less than $100 per month.

Mr. Berg.—I would like to inform Mr. Stannard that we have plate girders one hundred and twenty-two feet long.

Mr. Killam.—This question of bridge erection by the company's men, or by contractors, is a question that has been pretty well threshed out with us. We have two bridge gangs well fitted out and do much of the work with our own men. Though some of our new bridges are erected by the manufacturers, we can do it considerably cheaper than what the builders will do the work for.

Mr. Staten.—Most members think that when a bridge company comes to put up a bridge, that they have none but experienced men. This is the biggest mistake in the world. They come there and pick up every man around that will not work for us, and that we won't have work for us, and generally five or six of those fellows follow them off to the next job, and are then classed as experienced bridgemen.

Mr. McIntyre.—On our road we have always erected our own bridges. It is not necessary to have a large gang of competent bridgemen. Generally three or four are employed all the time. An additional force of cheaper men is added when necessary, the number depending upon the amount of work to be done.

VIII.—The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Gentlemen: The Committee on Subject No. 8 begs leave to submit the following report:

Circulars were sent to all members of our Association and to others whom it was thought would be interested in making replies. A gratifying number of replies were promptly received. Some members sent descriptions of their present tool car outfits, while others submitted recommendations of what they considered suitable for miscellaneous bridge work. In the appendix will be found a brief synopsis of these replies, with drawings and photographs to accompany same.

We regret our space does not permit the printing of those letters in detail, for they would be of much interest to all members who are called upon to devise suitable accommodation for men, and storage for tools and material. These letters plainly show, however, that the number, size, and equipment of cars, and the number of men in a gang, are determined by the class of work to be performed and the section of country in which the work is located. And they further show that, for similar classes of work in the same parts of the country, the equipment of cars varies but little in its general character.

The question of tool cars seems to resolve itself into making the best of what can be secured. In these days of brisk trade and extensive productions the car accountants are keeping very careful watch of cars of all kinds, and an old box car seems to be the best that most of us can secure for a tool car. However, given an old box car, the drawings, photographs, and descriptions show that very suitable, neat, and comfortable bunk and tool cars can be evolved from an humble beginning.

On the question of cost of fitting up these cars your committee has received very little data. The work generally seems to be done at the railway company's shops, or on the road by the bridge foremen themselves, and no very accurate record is kept of the expense.

Your committee feels that it would be impracticable to formulate any recommendations for particular styles or equipment of outfit cars, or for the number of men in a bridge gang, but takes great pleasure in submitting the sketches and descriptive matter and suggestions from the different members of our Association and others.

We feel sure our fellow members will agree with us that a

clean, light, comfortable bunk car and a neat and convenient tool car will do much toward promoting the efficiency of a crew of bridgemen; and we submit this brief report in the hope that it will be of interest and value to all who have any kind of outfit cars in their charge.

A. W. MERRICK,
Chairman,
S. S. MILLENER,
WM. M. CLARK,
A. A. PAGE,
M. F. CAHILL,
W. E. HARWIG,
G. O. LILLY,
Committee.

QUESTIONS ON SUBJECT NO. 8: "THE BEST AND MOST CONVENIENT OUTFIT CARS FOR BRIDGE GANGS AND NUMBER OF MEN CONSTITUTING A BRIDGE GANG," ANSWERS TO WHICH WILL BE FOUND IN APPENDIX TO REPORT.

1. Number of cars.

2. Size of car and kind.

3. Number of men car will accommodate.

4. General details of furnishings and fittings, such as benches, stoves, closets, tool racks, seats, smoke jacks, tool boxes below or above or both.

5. Air brake or train pipe.

6. Cost.

7. Number of men constituting a bridge gang: (a) Trestle and repair work; (b) Iron work.

APPENDIX TO REPORT OF COMMITTEE ON SUBJECT NO. 8,

MADE TO THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

A. W. Merrick, division engineer C. & N. W. Ry., Eagle Grove, Iowa:

1. One tool car for each gang.
2. 34-foot box car for bridge crew.
   34-foot box car for carpenter crew.
4. See drawing.
5. Air brake on carpenter car.
7. A foreman and six to eight men.

In connection with question No. 4 would say, that the outfit referred to was in use on the Dakota division of the C. & N. W. Ry. last year.

The two 34-foot box cars were fitted up alike. A room was partitioned off at one end for foreman, with single bunk, lockers, etc., balance of car was devoted to bunks for eight men, lockers, tool boxes, stove, etc. There was a box underneath car for tools and rope boxes on top.

The carpenter car shown on drawing was somewhat more elaborate. An old directors' car happened to be condemned, and some of the fittings were confiscated for the tool car. One of the berths was placed in the foreman's room, and many other little conveniences found their way into the car. No little pains was taken to make this a comfortable car for both foremen and men, and results were shown in the pride which the men took in keeping car neat and clean.

C. W. Vandergrift, C. & O. Ry.:

1. Four or five.
2. Old box cars.
3. Ten or twelve.

4. Foremen fit up cars to suit themselves. Where we have a large amount of trestle or bridge work we provide sleeping and dining cars fitted up from old box cars.

5. Hand brakes.

7. Eight to fifteen men.

H. M. Henson, C. & N. Ry., Gallatin, Tex.:

1. Four cars.

4. One old coach, with room at one end for foreman and ten bunks in balance of car for men. Car No. 2 should be fitted for cooking and dining car. An old baggage car 40 feet long is suitable for this, and will contain the necessary fittings. Car No. 3 will be a flat car to carry water tank on end next to kitchen of car No. 2, and also fuel and hand cars. A box car for tools completes the outfit.

R. L. Heflin, B. & O. Ry.:

1. Four cars.

4. One car, to be remodeled from an old passenger coach, to have office in one end for foreman, with stove, wardrobe, desk, water cooler, seat, etc. At other end of car partition off space for twelve bunks, six on each side, also stove, wash bowl, drawers, lockers, etc. In centre of car there is room for three bunks. Car No. 2 to be fitted up for kitchen and dining-room with all necessary furnishings. Car. No. 3 should be a 40-foot tool car, with racks and tool chests for tools. Car No. 4 should be a gondola, with coal bin at one end, and space for hand car, push car, and miscellaneous material for repairs.

M. Riney, superintendent B. & B., C. & N. W. Ry., Baraboo, Wis.:

1. One car, divided into five sections.

2. 28-foot box car, partition 12 feet long in one end.

3. Six to eight men.

4. Caboose stove, side benches, side racks for saws, bars, etc.

5. Air brake.

7. Six to eight on trestle work; twelve to eighteen on iron work.

B. F. Pickering, supervisor B. & M. Ry.:

1. Two cars.

2. One old baggage car and box car.

3. Get this from sketch.

4. See drawing. Car 32 feet x 9 feet was a baggage car and was fitted for sleeping and dining car by putting in car windows where there were no doors and changing side doors to windows. All windows fitted with screens.

5. Air brake and air signal.

7. Foreman, cook, and eight men.

W. M. Noon, superintendent B. & B., D. S. S. & A. Ry., Marquette, Mich.

1. Usually have four cars, diner, sleeper, tool, and flat car.

2. Dining car is usually an old coach, fitted up with dining room, kitchen, and sleeping room, and usually run by a man and wife.

3. Sleeping car will accommodate from six to sixteen men, generally an old box car or flat car fitted up with side and roof.

4. Sleeping car is fitted with bunks, stoves, and benches.

5. Have no air brakes, but some of the cars have train pipes.

7. Number of men from six to sixteen, according to work; usually twelve or fourteen for iron work.

C. P. Austin, supervisor B. & B., B. & M. Ry.

1. Two cars.

2. One boarding car and one tender.

3. Boarding and tender car will accommodate twelve men.

5. Air brakes on both cars.

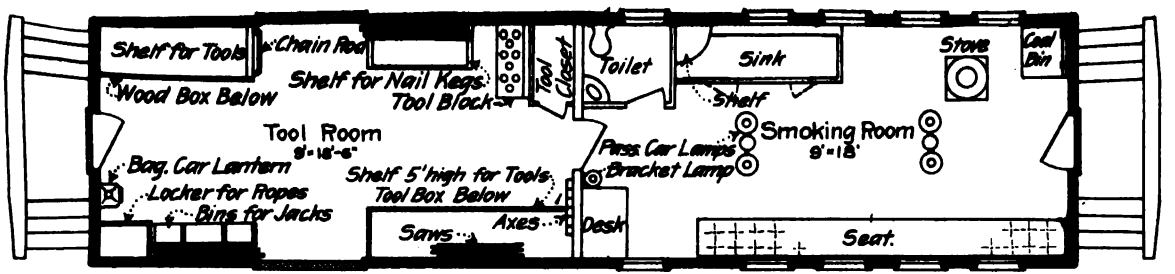
7. Ten men for erecting temporary bridge and twelve men for building or rebuilding iron bridges.

F. L. Burrell, superintendent B. & B., F. E. & M. V. Ry.:

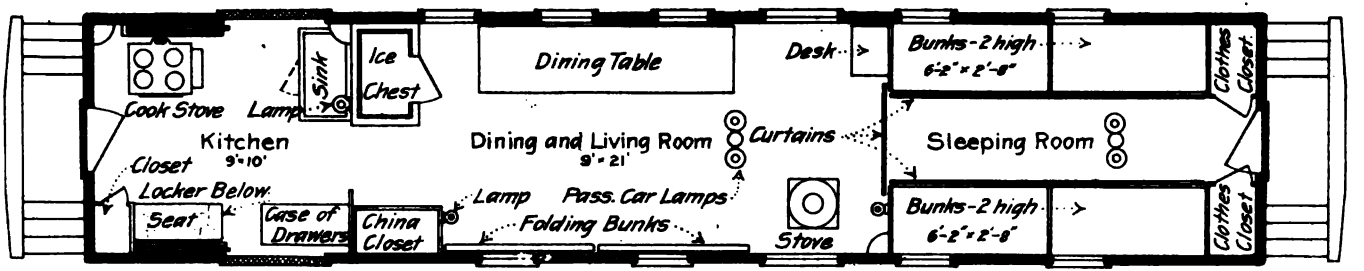
1. Two cars.

2. Retired stock cars are used. They are lined with grain door lumber, then tar paper, then flooring and painted on the inside with C. & N. W. standard No. 14 paint. One such car is used for sleeping car and a flat car accompanies it for material, etc.

4. The sleeping car is fitted up with two rows of bunks at one end, suitable for the accommodation of eight men. The other end is separated from sleeping compartment by a partition. In this are tool racks, way car stove, and desk. This part of the car is also designed to afford a resting-place for men when not at work. The flat car has a small tool house and one end for jacks, bars, etc., and the balance of the car is used for material.



BOSTON & MAINE RY.
COMBINATION TOOL CAR No. 3048



BOSTON & MAINE RY
BOARDING CAR No. 3249

FIG. 40.

5. No air brake.

6. Fitting of box cars cost about $20, and of flats $10.

7. Number of men depends upon magnitude of work; ordinarily I have six men. I have one gang of five men who are all Americans. One man is 6 feet 8¼ inches and the shortest man is 6 feet. These men will do as much as any other seven men.

Jas. Brady, Superintendent B. and B., C., R. I & P. Ry.:

1. Two cars for each gang.

2. One box car 10 feet x 42 feet, one flat car 8 feet x 34 feet.

3. Box car will accommodate nine men.

4. The box car, 10 feet x 42 feet, is fitted up with end platforms with one end partitioned off for office. This office is supplied with stove, desk, and bunks for three men. Other end of car has stove, tool racks, and closet. There are also bunks for six men. Underneath car is large cellar for picks, shovels, bars, etc.

The flat car, 8 feet x 38 feet, has housing at one end, 10 feet long, built in same manner as standard box car. In this are kept spikes, bolts, washers, etc., and on the balance of the car is carried lumber, plank, etc., for repairs.

5. Air brake.

6. No data.

7. On general repair work bridge gang consists of foreman and eight to ten men. On iron work the number of men depends upon kind and location of work.

Jas. McIntyre, Erie Ry. Co.:

Says he uses a common box car for tool car and men have no difficulty in finding board and lodging with the farmers along the road.

7. Generally speaking a gang of eight men is enough for renewing floors, rivets, etc.

J. P. Snow, B. & M. R. R.:

1. Two cars.

4. One boarding car, which is an old combination baggage and smoking car, fitted with eight bunks in baggage end and cooking range in the other end, with long table against one side in central part. Seven or eight chairs, small desk, and ice closet completes the furniture.

Tool car should be 45 feet or 50 feet long to give room for tools, rivet stock, and bench. Ladders are carried on rack un-

derneath car as it is not permitted to carry anything on top of cars. The outfit above described is used for small repairs and for strengthening iron bridges during the winter season, as well as erecting small girder structures and operating a sand blast apparatus during the summer.

A Montzheimer, Supt. B. and B., C. & N. W. Ry., Milwaukee, Wis.:

1. Nine cars on his division.

2. Mostly 34 foot cars and used most entirely for tools and material, except two which are fitted up with bunks for bridge men.

4. Stove, racks for tools, work bench with vice, etc.

5. One car provided with air brake.

6. These cars are second-hand box cars and I would not put cost very high.

7. All gangs run from six to ten men.

O. J. Travis, Superintendent of Bridges, Ill. Cent. Ry.:

1. Four to nine.

2. From 28-feet box to 60-feet coach.

3. Five to twenty.

4. Tool cars are provided with racks for augers, saws, axes, jacks, cant hooks, etc., and boxes and reels for rope, hooks for tackle blocks. Material cars are provided with bins for spikes, nails, bolts, washers, etc. These cars also carry torch baskets, steam boat ratchets, cannel-coal, rosin, pike poles, etc.

Office or foreman's cars are provided with desk and case of pigeon holes for stationery, stove, two chairs, wash basin, tank, etc. There is usually sleeping room for foreman and two to four men. Regular sleeping cars are provided with coach cane seats, closets and boxes for clothes, wash basin, and stove. All cars above mentioned have bracket lamps and cellars underneath.

Erection gangs have derrick car and flat car for carrying boom when running. In addition there is also provided for the derrick car a locomotive tender, blacksmith car with full complement of blacksmith's tools, some bar iron and tool steel. Other tool cars are carried with an erection gang, containing riveting forges, air compressors, air tools, etc.

5. Air brake on derrick car only, air pipe on all other cars.

6. Cars used are those discarded from revenue service and seats, tanks, basins, etc., are also discarded, hence cost of fitting does not exceed $35.

7. For trestle gang six to twelve men, for erection gang ten to twenty-five.

G. W. Smith, Asst. Supt. B. and B., C., M. & St. P. Ry.:

1. Sixty-one cars.

2. Cars which are too short and too old for regular service.

3. Tool cars and not for sleeping accommodation.

4. Cars are usually fitted with stove, tool box, and cellar underneath, windows, special doors, seats, racks, etc., are provided by each crew.

5. Either air brake or train pipe.

6. Indefinite.

7. Foremen and eight men for wooden trestle bridge work. (b) Foreman and ten to eighteen men.

J. M. Caldwell, C., I. & L. Ry., Lafayette, Ind.:

1. One tool car for each gang of a foreman and ten men.

2. A 40,000 capacity box car.

3. As a rule men do not travel or sleep in cars.

4. Ordinary caboose stove, rack and bins for storing bolts, washers, etc., and hooks for ropes and blocks.

5. Air brakes.

6. $400.

7. Repair gang, foreman and six men, rebuilding or heavy work, foreman and ten men; for iron work fifteen to fifty men, according to the size of the job.

W. O. Eggleston, Erie Ry., Huntington, Ind.:

1. Two bridge gang cars, one interlock car, one paint car, and one water supply car.

2. 8 feet 6 inches x 28 feet.

3. Men do not stay in cars.

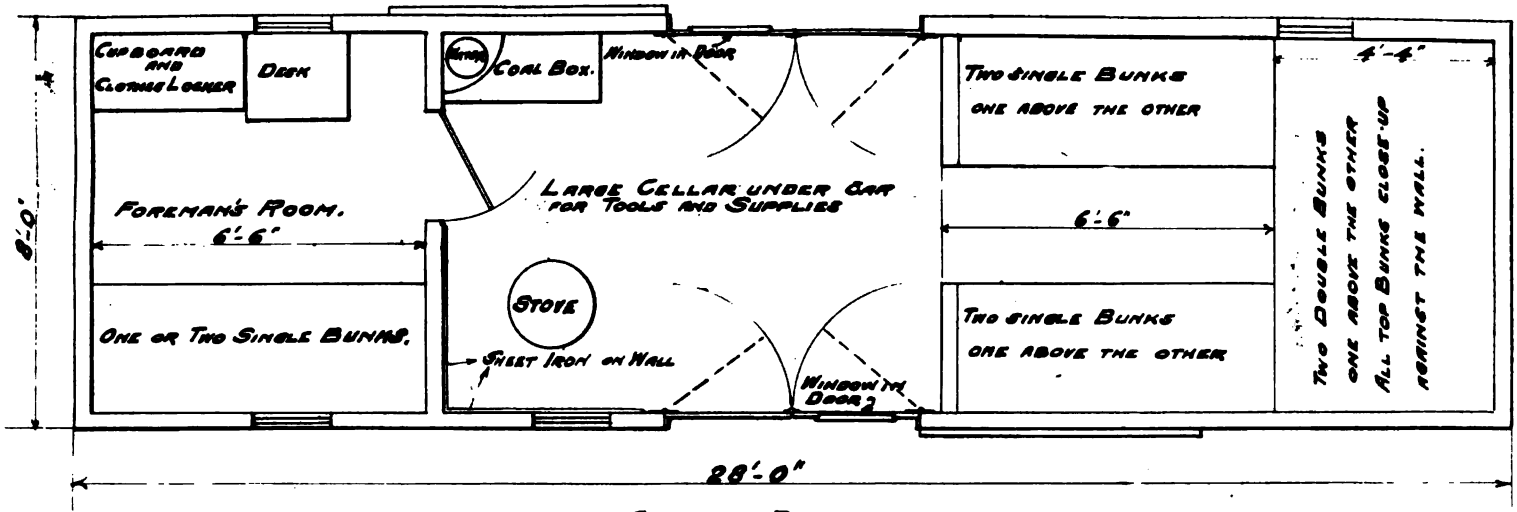
4. Stove, closet, tool racks, no seats, galvanized iron smoke jacks, tool boxes below and above.

5. Train pipe or straight air pipe.

7. This is governed to a great extent by the kind of job. (a) About twelve men. (b) Fifteen to twenty-four men.

G. F. Patterson, Central Vermont Ry., Waterbury, Vt.:

1. Tool car, storage car, dining and sleeping car.



GROUND PLAN.

SCALE ½"=1 FOOT

NOTE—MOST OF THE TOOLS ARE CARRIED IN A REGULAR TOOL CAR WHICH ACCOMPANIES THIS ONE

C. M. & St P. Ry.

BRIDGE AND BUILDING DEPT

OLD 28 FT. BOX CAR FITTED FOR SLEEPING AND TOOL CAR

FIG. 41.—Sleeping and Tool Car, C., M. & St. P. Ry.

2. Thirty-five foot car.

3. Ten men.

4. Tool boxes below, ladder on top.

5. Air brake.

7. Repair work, ten men. Iron work, twenty-five to thirty-five.

R. Rettinghouse, Supt. B. & B., C. & N. W. Ry., Kaukauna, Wis.:

1. Two cars for each crew.

2. Box cars 28 feet long.

3. Each boarding car will accommodate eight men.

4. Most cars are fitted up from old 28-foot box cars, and for each crew is provided a boarding car and tool car. See photographs.

5. No brakes.

7. (a) Foreman and eight men. (b) Do no iron work of consequence.

W. E. Smith, C., M. & St. P. Ry., Green Bay, Wis.:

1. A tool car and a sleeping car for each crew.

2. Old box cars, 28 feet to 33 feet.

3. Eight men.

4. Tool cars are fitted with a double door in one end so as to permit loading hand car. They have work bench and racks for the different kinds of tools.

The sleeping cars have a small room in one end for the foreman, which contains a bunk, cupboard, clothes closet, and a wall desk. The balance of the car contains double bunks for eight or more men, a table, regular caboose, side boxes for storing articles of any kind ; when covers of these boxes are down they serve as seats for the men. This room contains a stove which heats the whole car.

By building two double bunks across one end of the car, one above the other, and two single bunks on each side, one above the other, with their ends abutting against the double bunks, which leaves an aisle two feet or more wide, eight men can be accommodated. The upper bunks are sometimes hinged to the wall and their front sides suspended by chains, so that they may be closed up, making it possible to use lower bunks for seats.

5. Some air brakes and some train pipe.

7. Eight men, usually.

FIG. 42.—Boarding Car, B. & B. Dept., C. & N. W. Ry.

FIG. 43.—Boarding Car, B. & B. Dept., C. & N. W. Ry.

FIG. 44.—A Corner in Tool Car, B. & B. Dept., C. & N. W. Ry.

FIG. 45.—A Train of Boarding and Tool Cars, B. & B. Dept., C. & N. W. Ry.

FIG. 46.—A Corner in Boarding Car, B. & B. Dept., C. & N. W. Ry.

FIG. 47.—A Corner in Boarding Car, B. & B. Dept., C. & N. W. Ry.

James W. Gilbert, M., K. & T. Ry., Parsons, Kan.:

"Will say that we have three grades of B. & B. outfit cars. Division repair gangs on the north divisions have one 34-foot bunk car, which has an office in one end for the foreman and eight swinging bunks. Each man furnishes his chair. They have from one to three lockers for clothes, one heating stove, a wash sink. As a general thing they are fixed up according to the foreman's taste.

"Repair gangs have each a 30-foot flat car for emergency and carry ties, stringers, and caps for 30-foot openings. Each car has a cellar for tools and rope.

"The iron gang has a cook car, dining car, material car, box tool car, a 30-foot flat car, two bunk cars 30 feet and one 34 feet. They have all company tool boxes, three rope, and three large tool boxes, and a tarpaulin for engine. We also have a derrick car 36 feet long, made to order by the company, which works finely. Has a cast iron mast and a wrought iron boom. We use it for unloading all kinds of spans.

"Our repair gangs have about eight men."

J. H. Markley, M. of B. & B., T. P. & W. Ry., Peoria, Ill.:

"Have two cars. A painter's car and a car for fence gang. Found it necessary to put box on top of painter's car to carry ladders. Both cars have air brake and patent couplers."

See blue print of painter's car and cellar for same.

INTERCOLONIAL RAILWAY.

LIST OF CARS AND TOOLS AS FURNISHED BY THE I. C. R. FOR ERECTING AND REPAIRING IRON BRIDGES.

One boarding car fitted to accommodate 7 men.

One tool car (common box) fitted with shelves, benches, and boxes to carry the following tools :

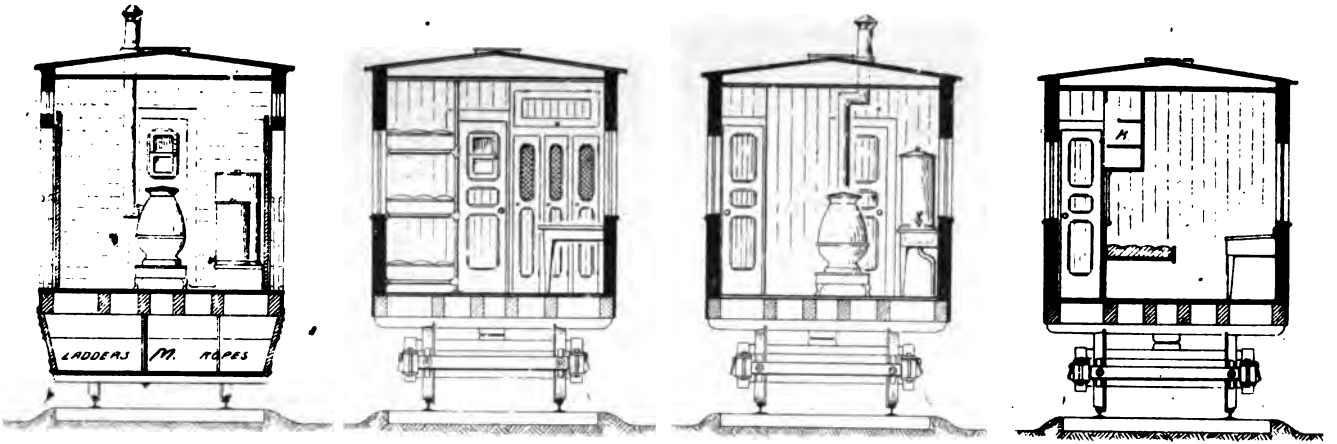
8 triple blocks (metalic sheave head check), size 18-inch sheave for 6-inch manilla rope.

8 double blocks 10-inch sheave, for 4½-inch rope.

3 sets double and single blocks, size 8-inch sheave for 3-inch rope.

JACKS.

2 60-ton tangies hydraulic bridge jacks, foot lift.
2 30 " " " " " "
2 20 " " " " " "
2 7-ton ordinary hydraulic jacks.



WORK ROOM - PLATFORM END.

SLEEPING ROOM.

PLATFORM END. WORK ROOM END

NOTE:- THE CELLAR 'M' IS DIVIDED INTO TWO COMPARTMENTS. ROPES ON ONE SIDE and LADDERS ON THE OTHER.

BOSS PAINTERS ROOM

FIG. 48.—Paint Car, T., P. & W. Ry.

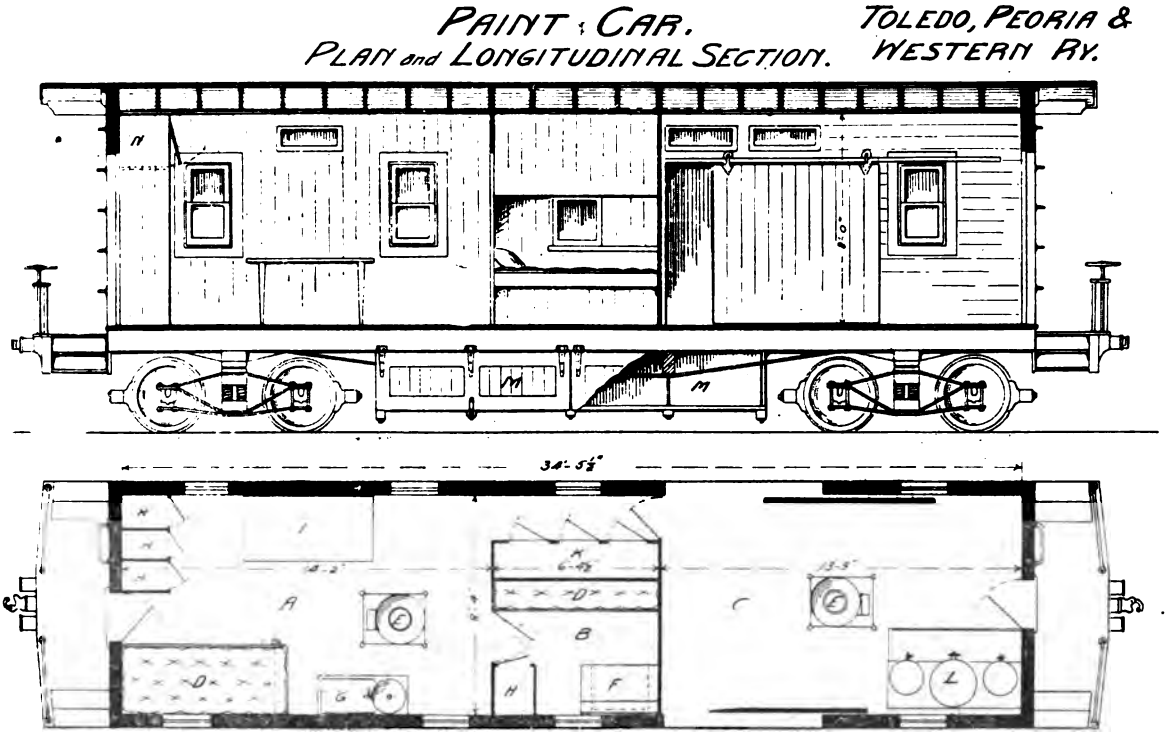
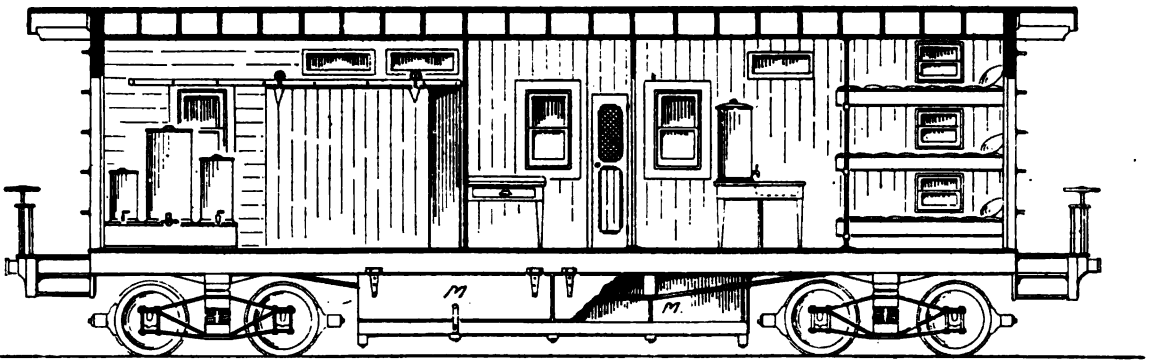


FIG. 49.—Paint Car, T., P. & W. Ry.

PAINT CAR.
LONGITUDINAL SECTION

TOLEDO, PEORIA & WESTERN RY.



DESCRIPTION:-

A.- SLEEPING ROOM.

B.- BOSS PAINTERS ROOM

C.- HAND CAR & WORK ROOM.

D.- BEDS.
3 tiers in Sleeping room.
1 tier in Boss Painters room.

E.- STOVES.

F.- DESK WITH DRAWER.

G.- SINK WITH WATER TANK.
open fixture.

H.- LOCKERS.
All lockers to have a cupboard above.

I.- TABLE WITH DROP LEAF.

K.- PANTRY and DISH CLOSET.
To open with doors into Passage

L.- OIL & PAINT TANKS.

M.- CELLAR.
To have two compartments. One side for ladders. the other for ropes.

FIG. 50.—Paint Car., T., P. & W. Ry.

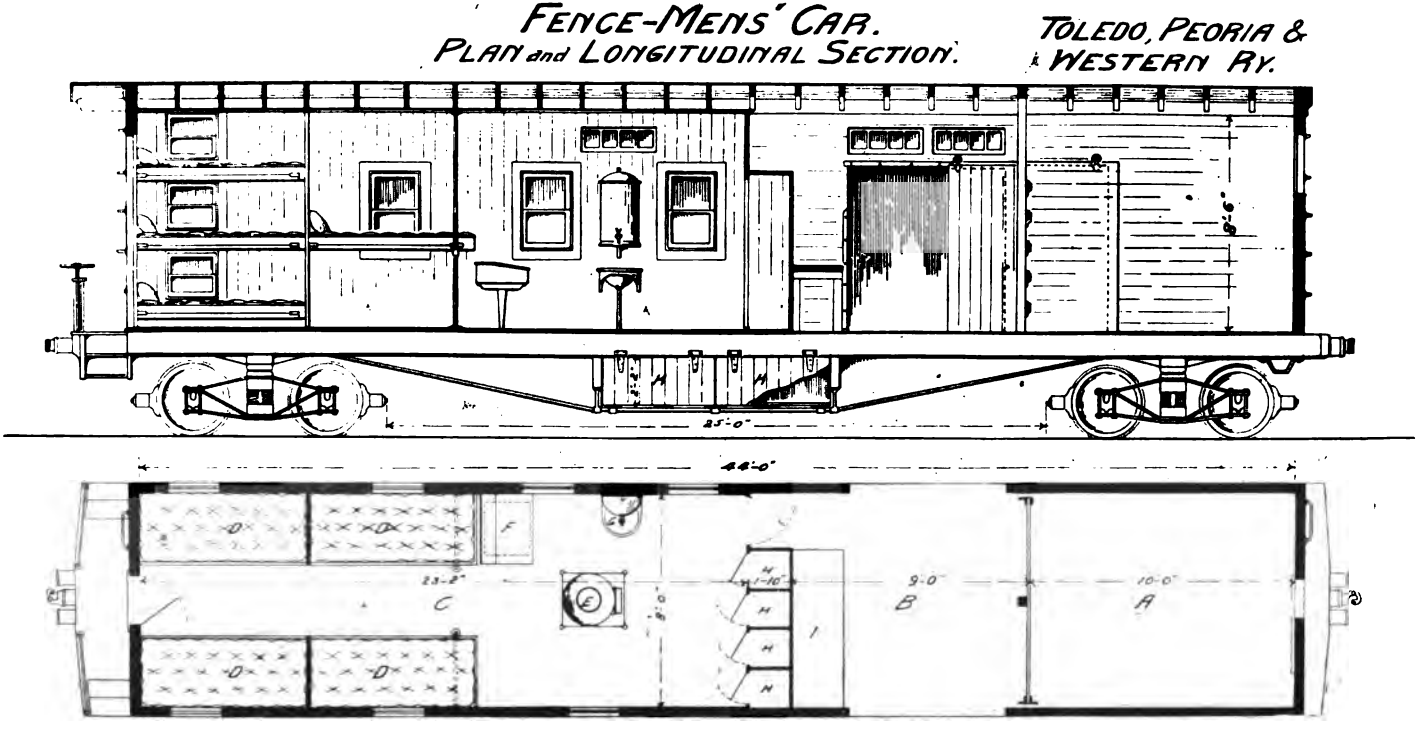
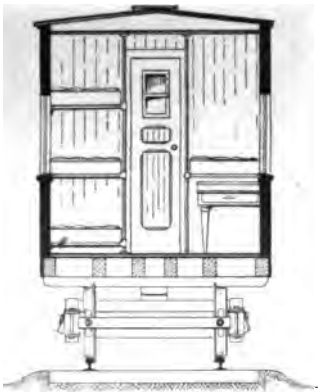


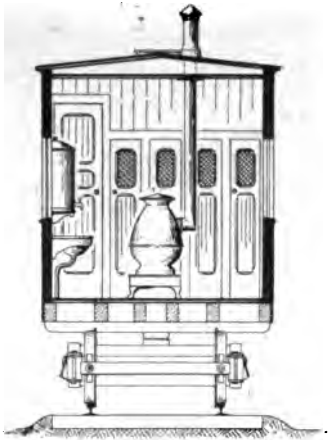
FIG. 51.—Fence Men's Car, T., P. & W. Ry.

Fence-Mens' Car.
Sections.

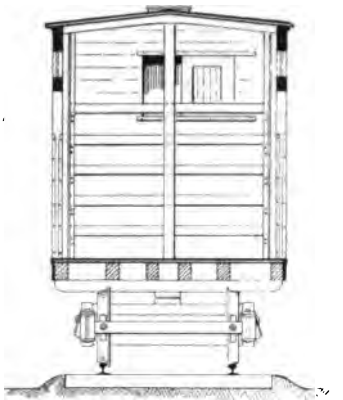
Toledo, Peoria & Western Ry.



Sleeping Room - Platform End.



Sleeping Room - Work Room End.



Work Room - Toward Wire Bin

Description:-

A.- Barbed Wire Bin.

B.- Hand Car and Work Room. Walls and Ceiling ceiled with M & O. ceiling. Floor Standard car flooring.

C.- Sleeping Room. Side walls, 1st M. & O. fencing, 2nd Paper, 3rd ½" Stock bds & battens lengthwise of Car. Ceiling ½" stock bds & battens. Flooring, 1st M & O fencing crosswise, 2nd Paper, 3rd H.P.S & flooring lengthwise.

D.- Beds. 3 Sections 3 tiers, 1 Section 1 tier.

E.- Stove.

F.- Desk. with drawer.

G.- Wash Bowl tank above.

H.- Lockers.- 6 Ft. high

I.- Work Bench

K.- Cellar - 2 doors each side.

Fig. 52.—Fence Men's Car, T., P. & W. Ry.

2 12-inch screw jacks.
2 25-ton Norton bridge jacks, foot lift and portable base for side moving.

RATCHETS.

4 ratchets, 2 feet 8 inches and 2 feet 10 inches, all drills made by hand, common blacksmith.

MANILLA ROPE.

600 feet 6-inch manilla rope, making 4 falls 150 feet each.
600 feet 4½-inch manilla rope, making 4 falls 150 feet each.
600 feet 3-inch rope gearing, three sets blocks for light hoist and guy work.
1 chain block, capacity 4 tons.

BRIDGE CARS.

2 cars especially constructed for bridge work with low wheels, deck being only three feet above rails. Capacity of cars 60,000 lbs. Two sets gantries for erecting carried on each car.

LAMPS.

6 barn lanterns.
4 signal lamps, 2 red 2 white.

FLAGS.

6 red and white.

ERECTING AND RIVETING TOOLS.

1 vice and set taps and dies.
2 portable forges.
1 anvil.
6 riveting cups.
4 riveting hammers.
4 snap hammers.
1 forge hammer.
1 sledge hammer.
6 augers.
2 cross-cut saws.
1 large punch, hydraulic, capacity ⅞-inch hole through ¾-inch iron.
1 gear drilling machine.
Staying plank and poles. Stage hangers.
1 grind stone and gear.
8 heavy double hooks for carrying heavy spans.
4 clevises of 2-inch iron for going through cap of gantries to suspend large blocks.
Pinch bars, spike pulling bars, hand chisels, chipping hammers, reammers, drift pins, erecting bolts, adzes, chipping axes, hand saw, cut spikes, board nails, board for templates, and numerous small tools not enumerated.

DISCUSSION.

Mr. Clark.—The matter of the amount of men necessary for constituting a bridge gang, that is, an economical bridge gang, depends greatly upon the amount of work and the class of work that you are doing. I generally, for general repairs, aim to have a gang of about ten. For light running repairs, I think a gang of five or six men should do. Of course, sometimes you will find work where you can use to advantage almost as many men as you are a mind to. At present I am re-lining a tunnel. On this I am working twelve men, but with us we aim for a bridge gang to consist of eight men, that gives us six men outside of the flagmen. The outfit for my men consists of three cars. We use one car entirely for a sleeping car, with probably a ten- or twelve-foot space in the center, that they use for a reading or writing room, or a sitting room as you may call it. The other car is fitted up as a kitchen and storehouse for the small tools and material that they do not want to put in the regular tool car. The regular tool car is simply a flat car with a cabin built on one end of it, and on the other end of this car we carry our push cars, hand cars, timber truck, and such tools as that. In the part of the flat car that is enclosed we have shelving on the two sides. The first shelf is about two and a ha'f feet up from the floor; under that shelf we generally have our spikes and such things as that stored, then we have about three shelves on each side, where we store our bolts, having each compartment marked to show the kind of bolts in it, say an eighteen-inch bolt; there is a place to put each separate length of bolts. Above that we have bins put in the frame in which we put our ropes, blocks, chains, and such things as that. That I believe is about all the information I can give on the camp cars.

Mr. Zimmerman.—I would like to ask Mr. Clark if he has any material for emergency carried on his outfit cars. On the Colorado & Southern Ry. we have one car for sleeping car and material, such as bolts, etc., and another regular material car that we keep loaded with bridge material, as we sometimes get in a hurry; we always endeavor to keep the cars well loaded with material so as to have it go with bridge gangs in case of burnouts and washouts.

Mr. Clark.—In answer to Mr. Zimmerman, we do n't carry a supply of timber on the cars. We frequently have to finish up a job of work, and if we have got two or three sticks, and they are short enough, in order to clean up the work, we throw them on the tool car, and then they are liable to stay there until the next job, and in the meantime, if we are called away, we do not aim to keep anything except nails, spikes, washers, packers, bolts, and such small things as that on the cars, but I would state that we always endeavor to keep on each of the divisions enough material to build one hundred feet of trestle work, and we keep that at the most advantageous point for engines and for loading, for instance, at a place where it is near a terminal, and in case of emergency we could turn the round house and section men to loading up whatever we wanted. With us it is very hard to get extra cars to put the timber on.

Mr. Stannard.—Will say our method is about the same as Mr. Clark's. I think eight to ten men about right for gang for economical work. This does not refer to small gangs on light repair work. We equip each gang with tool car prepared from box or baggage car remodeled to suit the service, and carry nothing except tools and good supply of bolts and washers, each gang having a hand, push, and velocipede car. Our men do not use their cars for sleeping. In my judgment, in a thickly settled country it is better to patronize boarding-houses along line. Of course there are localities where board cannot be obtained, then it would be necessary to bring the boarding car into requisition. We do not carry supply of timber with each gang, the tool car being the only cars accompanying gang. We keep material sufficient for a 100-foot opening loaded at headquarters, ready in case of emergency, so that pile driver and material can be dispatched on short notice; by this we save much delay in getting men out to load material outside of regular working hours.

Mr. Cummin.—I would like to ask Mr. Stannard whether the company pays the men's board, or whether the men board themselves?

Mr. Stannard.—The men board themselves.

Mr. Cummin.—That would n't work with us, because all our men are married men, and the wages they get and be away from

home all the time would not keep their families in one place and board themselves in another. I think by the time they got through there would not be much left.

Mr. Stannard.—You ought to increase their salaries.

Mr. Cummin.—Can't increase their salaries very well. Now as to cars, we have cars on the road not only for bridge men but also for the men in the building department. I think eight cars are out on the road the year round. Take men in the building department: they start in at one end of a division, have a boarding car, material car, etc.; they will start at one end of the division and go right through, repairing the stations and platforms and put everything in first-class shape, and then go on to the next station; and very often at one station they arrive at there are two or three days', or perhaps a week's, work, and at another station there would not be more than half a day's work. Now it would be impossible to be changing boarding houses at each one of these places, and at a great many places they could not get a place to board; but where we have only half a day's or a day's work, the foreman goes ahead and sees what there is to do, and leaves the boarding car at the last place; but where there are several days' work at a place, we hook the cars right on to a freight train and run down there. We could not get men to work for us if they had to pay their board; impossible to do it.

Mr. Zimmerman.—Do I understand Mr. Cummin to say that the company runs these boarding cars and pays the expenses of the men's board on these trips?

Mr. Cummin.—No, sir, the men board themselves in the car. They go out Monday morning, and usually take enough food to last a week; just whatever they want to take from home—fish, potatoes, etc. Butter and eggs they can buy cheaper out on the road than they can at home. The men tell me that the cost to them on an average is only about a dollar and a half a week to board themselves on the cars, and that it is better than they could get in a boarding house, and at a great many places they would not be able to get board. We furnish the cars, but they furnish their own food, and on an average it costs them about a dollar and a half a week, the way they live, for the reason, as I said before, they get all their vegetables very cheaply.

Mr. Cleaveland.—I have three boarding outfits, one on each

division, and we have a sleeping car that is manufactured out of an old passenger coach, in each one of these outfits, that is entirely filled with bunks, except possibly ten feet at one end, where there is a stove and a place to sit, and a box car generally is fitted up for a kitchen and dining-room. We carry no supply car or tool car. We have under the car what the boys call a "possom belly," in which we lock up any small supplies. The men keep these cars with them all the time, and board themselves, with the exception of a washout or a fire; the company generally provides the provisions in cases of this kind. In regard to the size of a gang of bridge men, I think that it is very hard to decide, we have so many men on each division, and I have the foreman of that division sub-divide that gang. Of course there are a great many jobs that we cannot use all the men on the job, and it is not a case of economy to have them in one another's way, but the foreman can send a few of these men out under an assistant foreman to some other job, and have two or three jobs going on at the same time. Now, in case of dock work, we sometimes have from fifty to seventy-five men in one gang, so I think it is very hard to determine or make a fixed rule as to the size of any gang on our work. We have to trust to the judgment of our foreman over the division to send the required number of men to each job.

Mr. Cummin.—While speaking a while ago, Mr. Stannard said I ought to pay my men more wages, and I would like to ask what they pay on the Wabash road.

Mr. Stannard.—Why, our standard pay for bridge men is $2.40 per day, and we pay as high as $3.00.

Mr. Cummin.—Our men get $2.50 per day.

Mr. Stannard.—More of our men get $2.60 and $2.75 than $2.40.

Mr. Cummin.—There is one thing in regard to this discussion about the gangs; it seems to all hinge on the bridge gang. I don't know how it is on other roads, but the expense in my department is a great deal more in the building department than in the bridge department, and I don't think I have heard any discussion about the building gangs whatever. My expenses for both men and material are very much greater for buildings than for bridges. I have in the neighborhood of five hundred build-

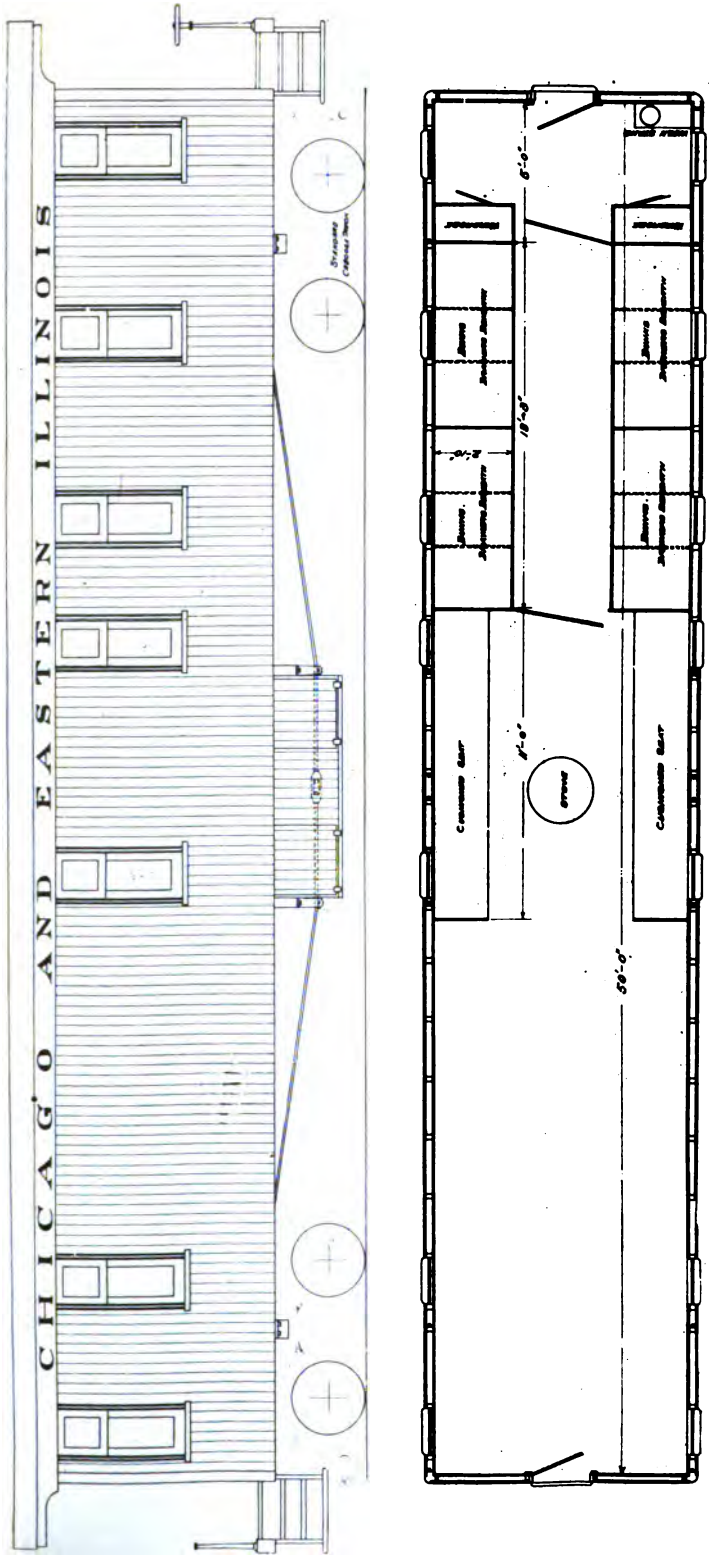


FIG. 53.—Fifty ft. Boarding Car, C. & E. I. R. R.

ings. Our main traffic is different from most of the railroads represented in this Association. As I understand it, the biggest part of your traffic is freight. Our main traffic is passenger. Last year we carried, I think, about 14,200,000 passengers in the year, and the great bulk of the traffic is done inside of four months. In order to accommodate that traffic we have to have extra long platforms. The passenger trains will run up to ten and twelve cars, and we find more trouble with one poor plank in a platform, and more expense, than we would with a broken tie on a bridge, because if there is a knothole that will take a French heel in, it is liable to cost the company anywhere from $1,500 to $2,000. The consequence is, the building gangs are kept going over these platforms continually, in order to prevent possible accidents. Another thing, we have to keep the painting gangs out all the time repainting, in order to keep things looking cheerful, and the natural consequence is, our expense in the building department is much greater than in the bridge department.

Mr. Markley (A. S.).—So far as the C. & E. I. is concerned, we equip our gangs with boarding cars. I have now four bridge gangs, four depot gangs, two paint gangs, two fence gangs, and three concrete gangs; all of them are equipped with boarding cars. In the fitting out of a bridge gang we have a car built especially for it—40-foot car, with room for twelve men in it. They do their own cooking in that car, and in addition to that they have a combination flat and box car, and in one gang a flat car and a box car, along with tools. We, as a rule, do not employ more than six or eight men in a bridge gang, and when it becomes necessary for emergency work, we try to employ additional men on the work, and when we leave the job we leave the men. In our concrete gang we keep about six men; they are what we call leaders, and they take the lead and the other men must follow or drop out. As for our wages, the best wages are $2.50 per day, foremen $75 per month.

Mr. Lichty.—I would like to ask Mr. Markley with reference to these boarding cars, whether the men do their own cooking, or whether the cook is furnished by the company.

Mr. Markley (A. S.).—The men furnish one of their own number, who does the cooking. He goes to the car at 11 o'clock to get dinner. They use generally a three-wheel car, and then after

the dinner meal is over they have the work divided—one washes the dishes, one gets the water, another the fuel, and at the end of the week they settle up by pooling the expenses by number of meals each man eats. All furnish their own bed and bed clothes.

Mr. Schall.—I would like to hear from some of the members what their men are paid for work done nights and Sundays.

Mr. Markley (A. S.).—We allow time and a half for Sundays, and two days for night work.

Mr. Killam.—The question now before the meeting, as I understand it, is the proper number of men to constitute a bridge-gang, and it is a prettty hard question to decide. It depends, to my mind, entirely on the nature of the work to be done. In one case you might get along with four or five men, and then another job fifteen or twenty, or as high as twenty-five, men might be required. Now, as to equipment, I might say that on the Intercolonial Railway we have two outfits, although it is a long road of thirteen hundred miles. We have a car similar to an ordinary second-class passenger car, with the seats all removed, and berths fitted up to accommodate fourteen to fifteen men. There is a small room made for the foreman for an office, also a small cook-room, and then the necessary berths, one above another, to accommodate the men, and the gang goes out and generally selects some young man as a cook, and the expense is borne by the crew, according to the number of men and what it costs to board them. The only case where the Railway boards the men is when it is a washout or some accident and they have got to go out without any notice, then the Railway pays the board bills; but in case of regular structural work, where it takes some time in a place, they deal with them as I have told you. We have this passenger car for a boarding car, and a box car fitted up to carry all kinds of tools, such as forges and all the jacks, ropes, and everything for doing structural work, in this car, and is kept in use for that purpose. Where there is work that requires extra men, we hire them in the vicinity of the work to be done. At these points the carpenters have to board themselves. We pay our carpenters $2.00 a day, for foreman, and a less sum for men under him, $1.20 and upwards, according to the man, in the lengthening of platforms and rebuilding them. According to the

work to be done is the number of men employed to do it as quickly as necessary. New buildings are done by contract work and inspected every day, as we generally have an inspector on the ground every day to look after the work, and to see that the contractor does the work properly.

Mr. Carpenter.—With us we have four bridge gangs, and we have a box car or a tool car with shelves arranged along each side at each end of the car for carrying supplies, bolts, spikes, nails, washers, etc., and over this we have racks made for crosscut saws, track augers, and other light tools. I regulate my gangs to about eight men, sometimes they do n't run over six, but six to eight men is an economical bridge gang, in my opinion. There are times when we can use sixteen men, and if I have work sufficient to guarantee that force I employ them. I sometimes have three or four jobs going on with four gangs of sixteen men. We also have a bunk car, just a box car in which bunks are arranged for as many men as we ordinarily keep in the gangs, usually foreman and eight men, and then we have, in addition to that, a flat car, on one end of which I always aim to carry at least one bridge chord, that is, stringers, ties, guard-rails, an extra cap or two, and on the other end, if they give us a long car, I carry my hand car, push car, derrick car, as almost all our gangs have a derrick car. In the building gangs they are run much the same way except instead of having a flat car we usually give them a box car in which to store such material as they will need for general repairs of depots, buildings, etc. The bridge gangs club together and employ a cook who does their cooking for them, and that cook they pay, and they provide their own victuals and cook them in that way. They go home every Saturday night, but go and come on their own time.

Mr. McIntyre.—I would like to ask Mr. Carpenter if the derrick that he speaks of is on a car?

Mr. Carpenter.—It is just nothing more than a push car with a light derrick on it. They use it out on the road for picking up a cap or a stringer, and anything like that.

Mr. Clark.—We pay our shop men twenty-five cents an hour, our bridge men twenty-four cents, and common laborers fifteen cents per hour. I have also been figuring the number of camp cars in service on our road and would say that I have thirty-two.

Every bridge gang has three, and every fence gang, painters, and stone men one and two, in fact, almost everybody that works in the maintenance of way department of our road has to have a camp car, and the way we are fixed on account of labor we have to have these cars just about as good as the other people have for the men, or they will not stay with us. One stone foreman went out one day and hired thirteen men to go to work the next morning; the next morning two of the thirteen showed up. He went that day and hired eight more; they came down the next morning, looked at the camp car, and said it would not suit them, and they all left. I have had several men getting $2.40 a day leave my employ this summer and walk right over to Pittsburg, and go to work at $2.75 or $3.00. Labor is very hard to get, both skilled and unskilled, with us. The mills are all running full, and it is almost an impossibility to get labor of any kind. We have got to have the accommodations for the men first-class in order to keep them.

President.—We would like to hear from the Southern members.

Mr. McGehee.—All of our bridge forces, carpenter forces, etc., are furnished with camp cars. The men board themselves; the foreman buys the provisions and hires the cook and charges the men what it costs. We keep a flat car with each bridge gang with enough material to build fifty feet of trestle.

Mr. Canty.—I do not understand how some roads handle their crews in boarding cars with cooks who are supposed to be one of the working crew. I am taking it for granted that crews number at least eight men. On our division we have men who do nothing but cook. They handle the commissary for crews varying in number from eight to twelve men, and are never idle. In view of the fact that our cooks work about twelve hours each day, I fail to see how this work can be done by one of the regular crew working an hour, more or less, before each meal.

Mr. Markley (A. S.).—We have worked our plan very successfully on our line. The men, of course, work it to the best advantage by preparing things ahead, boil beans at night, and do such work as that. That is the way they work it, and they get along very well that way, and I think it works a hardship on them to require them to pay $1.75 per day for a cook. It is

expensive, and does not overcome what we expect to overcome in our boarding cars.

Mr. Stannard.—I would like to inquire if there is anything in this subject in regard to boarding cars. I thought it was tool cars. I may be mistaken.

President.—The subject is, "The Best and Most Convenient Outfit Cars for Bridge Gangs, and the Number of Men Constituting a Bridge Gang." I should say that covers boarding cars.

Mr. Rettinghouse.—I would say that I wondered at the similarity of the arrangement between Mr. Markley's gangs and my own. Our gangs run their boarding cars in exactly the same manner. We have on the division six regular gangs, one painter's gang, and an extra gang; each of them have got cars. One of the men leaves the work at eleven o'clock, who does the cooking, and there is no question about its being done well, and in the evening he do n't leave the work until six o'clock and they have their supper late, and then after supper all join in and help clean up the dishes, etc.

Mr. Pickering.—I would just say that I am on the same system with Mr. Canty, and the railroad pays the cook, and the men themselves simply pay for the food which they consume, and their car is all furnished with the exception of light bedding, such as covers that they need over them in their bunks; otherwise the car is all furnished by the company, and we have found it economical in our experience. We tried Mr. Markley's plan and we found in our experience the best economy is to provide for the men so that they will not feel that we are crowding them a bit. The plan of trying to have one of the men in a gang do the cooking and the other men to make up the time will cause a man to feel that you are pinching him a little bit, and he will naturally pinch you back if he can, and he can every time. We have found the best economy is thus to provide for the cook, whom we pay $1.75 a day. Think the plan works very nicely.

Mr. Austin.—I would state on my division, as Mr. Pickering says, the company provide the cars, and furnish them throughout with everything except bed clothes and food. The company also furnish the cook and pay him $1.75 per day. He does all the buying and cooking, and keeps account of all expenses, takes care of everything in the car, and does not have anything else to do.

He gets up and gets breakfast, calls the men a half hour or so before breakfast is ready, and they eat their breakfast and are ready to go to work at seven o'clock in the morning. When it comes twelve o'clock the men all go to the car to dinner. When they get through dinner they all clear out and the cook takes care of the rest of it, and they have nothing more to do until they quit work at night at six o'clock. After supper is over they generally go into the storage car and enjoy themselves as they think best, and have nothing to do with the car until breakfast is ready the next morning. We have twelve berths, can seat twelve at the table. The berths, dining-room, and cook-room are in one car. The car is heated by hot water. The storage car carries all the stores, and the men keep their tools in it. At the end of every week the cook gives the amount expended and each one pays pro rata, from $1.70 to $2.00 per week.

Mr. Bell.—I am a little surprised at the different methods that some of the great railroad systems have. I am on a very small road, well to the south of here,—in fact, the only one in the Union that goes farther than us goes about thirty miles farther south than we do,—but we find it absolutely necessary to have a cook and to have a good one, and pay him about as well as any of the other men in the gang. I do n't see how the other roads can get along by using a man for a double purpose, that is, laborer in a gang and cook, as our cooks have work most all of the time, and we believe to benefit the company the greatest way possible is to get the best man we can, and keep him in the car continually, to keep the cars clean, cook for the men and to protect their things left in the car, as well as the company's, at all times. If not, we would not have anything in the cars, as our country is not very thickly populated and is infested with tramps. I think from what I have understood from the talks made by the other gentlemen present, that we are about as well fixed as any of the balance, in fact, as well as any.

Mr. Stannard.—Do your men ever carry their meals out with them?

Mr. Bell.—If it is too far for the cook to carry it, they carry it out with them, but do not do so if they can avoid it.

C. W. Vandergrift (written discussion).—I have no regular organized bridge force in my division, but all go prepared to make

such repairs as may be needed on bridges and to rebuild trestles. We put in all of our interlocking switches, and at present we have a good deal on hand. My forces all have shanty cars, which consist of three box cars, one fitted up to sleep in, one to cook and eat in, and one for tools, etc. Some of the bunks are fitted up with one-inch pipe, which I think make a neat bunk and leave no place for bedbugs to hide. We make these three bunks high, single, and as Mr. Staten said, the railroad company allow us $20 per month for cook in each force of hands, of which I have seven, including one painter's force. I work from six to twelve men in each force. When we have heavy work to do we double the forces, or in case of a washout or break in any way we double them up.

DISCUSSION OF COMMITTEE REPORTS

FOR 1899—1900.

CONTINUED FROM THE TENTH ANNUAL CONVENTION.

Is Concrete a Suitable and Economical Material for Bridge Piers, Abutments, and Railway Culverts and Arches?

Mr. W. A. Rogers, chairman of the committee, presents the following letter from Mr. J. S. Berry, chief engineer, Union Pacific R. R., received too late for publication in last year's proceedings. For meaning of reference numbers see Tenth Proceedings, Convention at St. Louis, page 154.

J. S. Berry, chief engineer, Union Pacific R. R. :—We have only been using concrete in large quantities during the year 1900. I will answer your questions in detail, as follows:

1. In all concrete work only use Portland cement. Have found the American Portland as good as foreign Portland in all bridge piers, abutments, concrete culverts, end walls for pipe culverts and retaining walls, and in all building foundations.

2. Use natural cement only in small buildings of various kinds, and then only during the summer months so that it has ample time to set before cold weather.

3. Use one cement, two sand, and four stone.

4. Use American Portland cement on all bridge structures where it is possible and economical to use it, culverts, etc.

5. One part cement, 3 parts sand, 5 parts broken stone, to pass through a 2-inch mesh.

6. Have no cement specifications.

7. Like clean, sharp sand, free from roots or clay.

8. In nearly all cases the quantity of concrete used is small, difficult to place a mixing machine, so that we have so far relied upon hand mixing. Measure the sand and cement and mix it dry, add water and mix it thoroughly, then add the stone, work

it over with shovels, and if it has to be thrown up or down it gets thoroughly mixed, probably better than by machine mixing if the quantity were great.

9. I prefer a dry concrete and do not care to bring the water to the surface as it has a tendency to wash the cement with it. Leave the top surface in each case rather rough so that the next course will bond well in with it.

10. In bridge abutments have had no trouble on account of cracks because of mixing and bonding it as noted in answer 9.

11. Make no special provisions for expansion and contraction, but in testing cements in the laboratory in addition to tensile strength we pay attention to the expansion of the cement and amount of water it takes.

12. If, on taking off the forms, the concrete face is rough we put a thin plaster of rich cement over it, and so far it has bonded in thoroughly and have had no trouble with it, but if the surface is very smooth take a pick and corrugate it so that it will bond well.

13. In all our work we use a plank form with the boards on the inside so as to get as smooth a surface as possible.

14. On one line of new construction work where it was impossible to get dimension stone, the work was of great magnitude and we had to work all one winter, at an elevation of 7,500 feet above sea level, where the winters are long, cold, and stormy. I bought two gasoline engines mounted on a mountain wagon, two Gates crushers mounted on a mountain wagon, and moved them from place to place where we could get small pieces of stone of sufficient hardness to crush, and built arches and abutments all winter. Arches from 4-foot span to 20 feet. Had considerable doubts as to what the result might be, but during the extreme cold weather housed them in, and in some cases kept a stove going. This summer they are all in first-class shape except a few small cracks.

15. Cement plastered on a surface and subject to the action of the frost will invariably scald and scale off in cold weather, but where it is in a mass and care is taken to heat the sand and water, and if necessary to house it in as I noted above, you can do good concrete work in the winter.

16. Where we buy broken stone for 50 cents a ton, no charges for transportation of any kind of material, where it is used on maintenance of way, with Portland cement, labor $1.50 to $1.75 per day, sand 10 to 15 cents per yard, and in small jobs of from 80 to 210 yards it has cost about as follows: In the small jobs of from 80 to 100 yards, about $4.00 a yard, 100 to 150 yards in a job, about $4.00 per yard. We have had some cases run up

as high as $6.50. In large jobs, say 225 to 250 yards, we have done it as low as $3.50 a cubic yard. Where, such as I speak of on new construction, on which labor was $2.00 a day; sand—plus transportation by train, 75 cents a ton; Portland cement—plus freight and teaming it over 4 to 6 miles from the railroad, with all the disadvantages of doing it in the winter, our work averaged $9.50 a cubic yard.

18. There is very little difference between masonry and concrete work where the stone is handy, but if you take into consideration the long haul and ability to get a good concrete stone where it would be impossible to get even good rubble, the concrete work is cheaper.

19. Nothing to say.

20. Would not hesitate to use concrete in any railway bridge or building work. Would use it in preference to many kinds of stone, but if the building stone was good and the work could be done cheaper than concrete would use it.

LIST OF ANNUAL CONVENTIONS.

First Convention,	St. Louis, Mo.,	September 25, 1891.
Second Convention,	Cincinnati, Ohio,	October 18, 19, 1892.
Third Convention,	Philadelphia, Pa.,	October 17 to 19, 1893.
Fourth Convention,	Kansas City, Mo.,	October 16 to 18, 1894.
Fifth Convention,	New Orleans, La.,	October 15, 16, 1895.
Sixth Convention,	Chicago, Ill.,	October 20 to 22, 1896.
Seventh Convention,	Denver, Col.,	October 19 to 21, 1897.
Eighth Convention,	Richmond, Va.,	October 18, 19, 1898.
Ninth Convention,	Detroit, Mich.,	October 17, 18, 1899.
Tenth Convention,	St. Louis, Mo.,	October 16 to 18, 1900.
EleventhConvention,	Atlanta, Ga.,	October 15 to 17, 1901.

MEMBERSHIP.

Year 1891–2. . . .	Number of active members, 60.
Year 1892–3. . . .	Number of active members, 112.
Year 1893–4. . . .	Number of active members, 128.
Year 1894–5. . . .	Number of active members, 115.
Year 1895–6. . . .	Number of active members, 122.
Year 1896–7. . . .	Number of active members, 140.
Year 1897–8. . . .	Number of active members, 127.
Year 1898–9. . . .	Number of active members, 148.
Year 1899–1900. . .	Number of active members, 148.
Year 1900–01. . . .	Number of active members, 143.
Year 1901–02. . . .	Number of active members, 171.

LIST OF OFFICERS OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS FROM ITS ORGANIZATION TO THE YEAR 1901-1902.

Year.	1891-2.	1892-3.	1893-4.	1894-5.
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews.
First Vice-President	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle.
Second Vice-President	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford.
Third Vice-President	James Stannard	N. W. Thompson.	L. K. Spafford	James Stannard.
Fourth Vice-President	G. W. Hinman	C. E. Fuller	E. D. Hines	Walter G. Berg.
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid.
Executive Members	W. R. Damon	G. W. Andrews	Quintine McNab	James Stannard.
	G. W. Markley	Joseph M. Staten.	Aaron S. Markley	James H. Travis.
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	Joseph H. Cummin.
	G. W. McGehee	Quintine McNab	James Stannard	R. M. Peck.
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White.
	J. E. Wallace	Aaron S. Markley	Joseph H. Cummin	A. Shane.

Year.	1895-6.	1896-7.	1897-8.	1898-9.
President	W. A. McGonagle	James Stannard	Walter G. Berg	Joseph H. Cummin.
First Vice-President	L. K. Spafford	Walter G. Berg	Joseph H. Cummin	Aaron S. Markley.
Second Vice-President	James Stannard	Joseph H. Cummin	Aaron S. Markley.	C. C. Mallard.
Third Vice-President	Walter G. Berg	Aaron S. Markley	G. W. Hinman	Walter A. Rogers.
Fourth Vice-President	Joseph H. Cummin	R. M. Peck	C. C. Mallard	Joseph M. Staten.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members.	R. M. Peck	W. O. Eggleston	George J. Bishop	Wm. S. Danes.
	J. L. White	W. M. Noon	C. P. Austin	J. H. Markley.
	A. Shane	Joseph M. Staten	M. Riney	W. O. Eggleston.
	Aaron S. Markley	George J. Bishop	Wm. S. Danes	R. L. Heflin.
	W. M. Noon	C. P. Austin	J. H. Markley	Frank W. Tanner.
	Joseph M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman.

Year.	1899-1900.	1900-1901.	1901-1902.
President	Aaron S. Markley	W. A. Rogers	W. S. Danes
First Vice-President	Walter A. Rogers	W. S. Danes	B. F. Pickering
Second Vice-President	Joseph M. Staten	B. F. Pickering	A. Shane
Third Vice-President	Wm. S. Danes	A. Shane	A. Zimmerman
Fourth Vice-President	B. F. Pickering	A. Zimmerman	C. C. Mallard
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer
	R. L. Heflin	H. D. Cleaveland	W. E. Smith
	F. W. Tanner	F. W. Tanner	A. W. Merrick
	A. Zimmerman	A. Montzheimer	C. P. Austin
	H. D. Cleaveland	W. E. Smith	C. A. Lichty
	A. Montzheimer	A. W. Merrick	W. O. Eggleston

SUBJECTS FOR REPORT AND DISCUSSION, AND COMMITTEES SELECTED AT EACH CONVENTION SINCE ORGANIZATION OF THE ASSOCIATION IN 1891.

FIRST CONVENTION, ST. LOUIS, MO., SEPTEMBER 25, 1891.

Subjects.	Committees.
1.	
Surface Cattle-Guards	Aaron S. Markley, J. B. Mitchell, W. R. Damon.
2.	
Frame and Pile Trestles Complete, including Rerailer	H. M. Hall, W. A. McGonagle, G. W. McGehee.
3.	
Framing and Protection of Howe Truss and Other Wooden Bridges against Fire and Decay	J. E. Johnson, G. W. Markley, J. H. Markley.
4.	
Iron and Vitrified Pipe for Waterways under Railroad Embankments	James Stannard, J. O. Thorn, J. E. Wallace.
5.	
Water-Tanks Complete, including Painting, Pumps, Pump and Coal Houses, Wells and Reservoirs	G. W. Turner, R. K. Ross, Q. McNab.
6.	
Interlocking Signals	B. F. Bond, G. W. Hinman, James Demars.
7.	
Depot Platforms, Complete	J. A. Nicholson, Adam McNab, C. B. Keller.
8.	
Paints for Iron Structures	Geo. M. Reid, A. J. Kelley, H. A. Hanson.

SECOND CONVENTION, CINCINNATI, O., OCTOBER 18 AND 19, 1892.

1.	
Discipline, and Benefits Derived, and Who are the Beneficiaries	Geo. W. Andrews, W. R. Damon, T. M. Strain, G. W. Turner.
2.	
Turn-table, Best, with a View of Economy, and Durability, and Strength	G. W. Markley, H. F. Martin, James H. Travis. Charles Walker.
3.	
Water Columns, Best, Cheapest, Simplest, and Most Durable	C. E. Fuller, A. S. Markley, H. N. Spaulding, E. L. Cary.
4.	
Coaling Stations, including Storage Bins and for Coaling Engines	J. E. Wallace. C. W. Gooch, G. W. Hinman. J. H. Cummin.

5.

Crawling of Rails, and its Effects on Structures.....	Geo. M. Reid, L. K. Spafford, J. B. Mitchell, L. S. Isdell.

6.

Guard-Rails on Bridges, Advantages and Disadvantages, and Best to be Adopted	O. J. Travis, Q. McNab, J. F. Mock, J. M. Staten.

7.

Platforms, Height and Distance from Rail and Mode of Construction.....	James Stannard. M. Walsh, N. M. Markley, Robert Ogle.

8.

Best Bridge, Wood, Combination, or Iron, from 130 feet and upwards, and the Best Method of Reconstruction.....	A. Shane, Walter Ransom, N. Potter, C. G. Worden.

9.

Best Method of Elevating Track upon Bridges and Trestles	H. E. Gettys, S. F. Patterson, G. W. Hinman, P. N. Watson.

THIRD CONVENTION, PHILADELPHIA, PA., OCT. 17, 18, AND 19, 1893.

1.

Depressed Cinder Pits and Other Kinds	W. G. Berg, Abel S. Markley, G. W. Andrews, C. E. Fuller.

2.

Best Method of Bridge Inspection..... ...	G. M. Reid, J. M. Staten, Geo. J. Bishop, J. S. Berry.

3.

Pumps and Boilers.....	G. W. Markley, G. W. Turner, J. B. Mitchell, J. R. Harvey.

4.

Maintenance of Pile and Frame Trestle.....	W. A. McGonagle. J. H. Markley, Geo. C. Nutting, John Copeland.

5.

The Best Scale Foundation.....	O. J. Travis, Joseph Doll, C. D. Bradley, T. M. Strain.

FOURTH CONVENTION, KANSAS CITY, MO., OCT. 16, 17, AND 18, 1894.

1.

Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges	G. W. Andrews, W. G. Berg, J. E. Greiner, E. H. R. Green.

2.

Methods and Special Appliances for Building Temporary Trestles over Washouts and Burnouts.....	R. M. Peck, G. J. Bishop, A. B. Manning, C. D. Bradley.

3.

Strength of Various Kinds of Timber Used in Trestles and Bridges, Especially with Reference to Southern Yellow Pine, White Pine, Fir, and Oak...	W. G. Berg, J. H. Cummin, John Foreman, H. L. Fry.

4.		
Best Method of Erecting Plate-Girder Bridges	..	H. M. Hall, J. M. Staten, G. W. Hinman, J. N. Pullen.
5.		
Best and Most Economical Railway Track Pile-Driver	.....	J. L. White, A. C. Davis, J. F. Mock, James T. Carpenter.
6.		
Sand Dryers, Elevators, and Methods of Supplying Sand to Engines, including Buildings	.....	Aaron S. Markley, H. A. Hanson, A. J. Kelley, J. O. Thorn.
7.		
Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate-Girders and Lattice-Bridges for Spans from 50 to 110 feet	.....	W. A. McGonagle, R. M. Peck, W. M. Noon, H. E. Gettys.
8.		
Best Method of Spanning Openings too Large for Box Culverts, and in Embankments too Low for Arch Culverts	....	James Stannard, L. K. Spafford, O. H. Andrews, F. W. Tanner.
9.		
Best End Construction for Trestle Adjoining Embankments	.....	G. M. Reid, J. L. Soisson, N. M. Markley, R. J. Howell.
10.		
Interlocking Signals	.....	J. H. Travis, W. S. Danes, R. L. Heflin, J. A. Spangler.
11.		
Pumps and Boilers	.....	John H. Markley, O. J. Travis, A. Shane, G. W. Markley.

FIFTH CONVENTION, NEW ORLEANS, LA., OCTOBER 15 AND 16, 1895.

1.		
How to Determine Size and Capacity of Openings for Waterways	.....	Aaron S. Markley, J. S. Berry, C. C. Mallard, J. L. White.
2.		
Different Methods of Numbering Bridges. Should All Waterways be Numbered?	.....	A. Shane, W. O. Eggleston, J. L. Slosson, O. J. Travis.
3.		
Drawbridge Ends, Methods of Locking; and under this head include Locking of Turn-tables	.....	H. M. Hall, James Stannard, H. Middaugh, C. C. Mallard.
4.		
Protection of Trestles from Fire, including Methods of Construction	....	R. M. Peck, T. H. Kelleher A. McNab, W. M. Noon. G. W. Hinman, William Berry.
5.		
Local Stations for Small Towns and Villages, giving Plans of Buildings and Platforms	.....	J. H. Cummin, N. M. Markley, J. H. Markley, C. G. Worden.
6.		
Tanks, Size, Style, and Details of Construction, including Frost-proof protection to Tank and Pipes	..	W. O. Eggleston, W. M. Noon, A. McNab, N. W. Thompson.

7.

Shearing of Rivets in Plate-Girders and Cause Thereof	J. M. Staten, R. L. Heflin, J. H. Travis, G. M. Reid.

8.

Best and Uniform System of Report Blanks for Bridge and Building Department	G. J. Bishop, W. O. Eggleston, Onward Bates, M. Riney.

9.

Protection of Railroad Structures and Buildings from Fire	R. M. Peck, L. K. Spafford, B. T. McIver.

10. Brought forward from 1894.

Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges	G. W. Andrews, W. G. Berg, J. E. Greiner, E. H. R. Green.

11. Brought forward from 1894.

Best and Most Economical Railway Track Pile-Driver	J. L. White, A. C. Davis, J. F. Mock, J. T. Carpenter, G. W. Hinman.

12. Brought forward from 1894.

Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate-Girders and Lattice Bridges for Spans from 50 to 110 feet	W. A. McGonagle R. M. Peck, W. M. Noon, H. E. Gettys, G. J. Bishop, Onward Bates.

13. Brought forward from 1895.

Interlocking Signals	J. H. Travis, W. S. Danes, R. L. Heflin, J. A. Spangler.

SIXTH CONVENTION, CHICAGO, ILL., OCTOBER 20, 21, AND 22, 1896.

1.

Methods of Heating Buildings where Three or More Stoves are Now Used	J. H. Cummin, George W. Hinman, George W. Markley, Wm. Berry.

2.

The Most Suitable Material for Roofs of Buildings of All Kinds	R. M. Peck, G. W. Turner, W. M. Noon, N. W. Thompson.

3.

Roundhouse Construction, including Smoke-jacks and Ventilators	Geo. W. Andrews, O. J. Travis, W. O. Eggleston, James T. Carpenter.

4.

Care of Iron Bridges after Erection	James H. Travis, T. M. Strain, H. M. Hall, Walter Rogers.

5.

How to Determine Size and Capacity of Openings for Waterways	Walter G. Berg, Aaron S. Markley, Onward Bates, A. J. Kelley.

6.

Protection of Railroad Buildings and Other Structures from Fire	W. A. McGonagle, M. M. Garvey, J. D. Hilderbrand, John Foreman.

7.

Designs for Ice-Houses	W. B. Yereance, C. M. Large, J. H. Markley, Geo. W. Ryan.

8.

Best End Construction for Trestles adjoining Embankments	C. C. Mallard, W. S. Danes, R. L. Heflin, A. C. Olney.

9.

Bridge Warnings for Low Overhead Structures	W. E. Harwig, M. A. Martin, E. H. R. Green, Joseph Doll.

10.

Stock-yards and Stock-sheds, including all Details of Construction	Geo. J. Bishop, W. R. Cannon, O. H. Andrews, James Brady.

11.

Floor System on Bridges, including Skew Bridges	W. G. Guppy, C. P. Austin, C. W. Gooch, F. W. Tanner.

SEVENTH CONVENTION, DENVER, COL., OCTOBER 19, 20, AND 21, 1897

1.

Pile-rings and Method of Protecting Pileheads in Driving	G. W. Hinman, Wm. S. Danes, F. Eilers, E. F. Reynolds, Wm. Carmichael, C. M. Large.

2.

Cost and Manner of Putting In Pipe Culverts	Walter A. Rogers, Frank W. Tanner, John H. Markley, A. H. King, B. F. Bond, O. H. Andrews.

3.

Best Floors for Shops and Roundhouses	A. W. Merrick, C. S. Thompson, Wm. O. Eggleston, M. F. Cahill, J. B. Pullen, James Gilbert.

4.

Roundhouse Smoke-jacks and Ventilation	George W. Andrews, Wm. O. Eggleston. Aaron S. Markley, R. J. Howell, J. T. Carpenter, A. McNab.

5.

Cattleguards and Wingfences	C. C. Mallard, C. S. Thompson, A. Zimmerman, L. H. Wheaton, O. W. Osborne, R. L. Heflin.

6.

Prevention of Fire in Railroad Buildings	John D. Isaacs, Wm. A. McGonagle. M. Riney, H. L. Fry, J. P. Snow, Wm. B. Yearance.

7.

Storage of Fuel, Oil, and Other Station Supplies at Way-stations	Arthur Montzheimer. A. Shane, G. E. Hanks, J. E. Johnson, W. Z. Taylor, E. M. Gilchrist.

8.

Railroad Highway Crossing Gates	Joseph H. Cummin. J. B. Sheldon, Wm. E. Harwig, G. W. Smith, J. E. Featherston, W. M. Noon.

9.

What Repairs, and How Can they be Safely Made, to Metal and Wooden Spans Without the Use of False-work	F. S. Edinger, B. W. Guppy, J. E. Greiner, John D. Isaacs, Walter A. Rogers, H. W. Fletcher.

10.

Care of Iron Bridges After Erection, including Best Method of Protecting Them From Injury by Salt Water Drippings from Refrigerator cars	J. E. Greiner, B. W. Guppy, James McIntyre, T. M. Strain, A. J. Kelley, L. F. Goodale.

11.

Turntable Construction	Onward Bates, J. B. Sheldon, D. K. Colburn, John Foreman, E. Fisher, Henry Goldmark.

EIGHTH CONVENTION, RICHMOND, VA., OCTOBER 18 AND 19, 1898.

1.

What is the Most Economical Method of Painting Railway Bridges and Buildings, and Best Material to use	A. Montzheimer, B. F. Pickering, H. D. Cleaveland, W. A. McGonagle.

2.

Life of Different Kinds of Timber in Bridges of Various Kinds, and Advisability of Protecting Same from the Weather	B. W. Guppy.

3.

The Best Method of Constructing and Maintaining Highway and Farm Crossings	J. H. Markley, W. O. Eggleston, T. M. Strain, O. J. Travis.

4.

Best Practical Sanitary Arrangement for Local Stations where there are no Water or Sewer Systems.	W. A. Rogers, J. B. Sheldon, C. H. Miller, J. McIntyre.

5.

Best and Most Economical Plant for Pumping Water for Water Stations	A. Shane, A. S. Markley, R. L. Heflin, W. E. Smith.

6.

Necessary and Kind of Tools for the Proper Equipment of a Gang of Bridge Men	G. J. Bishop, G. W. Hinman, M. Riney, A. Zimmerman.

7.

Best Snow Fence—Stationary and Portable	A. W. Merick, A. E. Killam, J. D. Isaacs. A. H. King.

8. Brought forward from 1897.

What Repairs and How Can They Be Safely Made to Metal and Wood Spans Without the Use of False Work	F. S. Edinger, J. E. Greiner, J. D. Isaacs, W. A. Rogers, H. W. Fletcher.

9. Brought forward from 1897.

Prevention of Fire in Railroad Buildings.....	G. W. Andrews, A. D. Schindler, W. E. Smith, S. B. Rice.

NINTH CONVENTION, DETROIT, MICH., OCTOBER 17 AND 18, 1899.

1. Brought forward from 1898.

Necessary and Kind of Tools for the Equipment of a Gang of Bridge Men.....	W. S. Danes, J. M. Staten, W. O. Eggleston, J. M. Caldwell.

2. Brought forward from 1898.

Best Snow Fence, Stationary or Portable.....	W. E. Smith, A. McNab, Geo. E. Hanks, A. W. Merrick. W. M. Noon.

3.

Best Method of Erecting Track Scales, Suspended or under Track.....	H. D. Cleveland, Wm. M. Clark, C. P. Austin, J. T. McIlwaine.

4.

Is Concrete the Most Suitable and Economical Material for Bridge Piers and Abutments and Railway Culverts and Arches?.....	W. A. Rogers.

5.

Hand *vs.* Air-riveting Power Used. Actual Cost Compared with Hand Work in the Field for the Erection of New Work and Repairing; also Drilling for Reinforcing old Spans.....	A. B. Manning, A. Shane, Geo. J Bishop, O. J. Travis, F. W. Tanner, F. S. Edinger.

6.

Most Practical and Cheapest Bumper for Yard Terminals.....	B. F. Pickering, A. A. Page, W. E. Harwig, A. E. Killam.

7.

Are Tie Plates on Bridge Ties a Benefit or a Detriment?.....	C. A. Lichty, A. Montsheimer, C. W. Vandergrift, H. W. Fletcher, F. S. Edinger, J. B. Sheldon.

TENTH CONVENTION, ST. LOUIS, MO., OCT. 16, 17, AND 18, 1900.

1.

Methods of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under.....	G. W. Andrews, C. C. Mallard, C. A. Lichty, C. W. Gooch, C. S. Thompson, D. Robertson.

2.

Passenger Platforms at Way Stations, Best Material and Cost of Same.....	J. B. Sheldon, John I. Banks, N. H. La Fountain, L. H. Wheaton, Wm. A. Fort, A. McNab.

3.

Slips for Ferry Boats Used for Transferring Railway Cars.....	John D. Isaacs, H. D. Cleaveland, J. H. Cummin, Charles Carr, H. Rettinghouse, J. T. Carpenter

4.

Best Method of Operating Turn-tables by Power....	F. E. Schall, J. E. Greiner, B. F. Pickering, Onward Bates.

5.

Auxiliary Coaling Stations; Best Design, Capacity, and Method of Handling Coal.....	W. A. McGonagle, G. W. Smith E. Fisher, J. P. Snow, B. F. Bond, R. B. Tweedy.

6.

Water Stations; Best Material for Foundations, Tanks, Substructure, Connections, Capacity, etc...	A. S. Markley, Charles Carr, W. O. Eggleston, A. J. Austin A. Shane.

7.

Is it Best for Railroad Companies to Erect Their Own Steel Structures, or Let the Manufacturers Erect Them?.....	O. J. Travis, F. S. Edinger, A. B. Manning, James McIntyre, A. Zimmerman.

8.

The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang.....	A. W. Merrick, S. S. Millener, Wm. M. Clark, A. A. Page, M. F. Cahill, W. E. Harwig, G. O. Lilly.

ELEVENTH CONVENTION, ATLANTA, GA., OCT. 15, 16, AND 17, 1901.

1.

Auxiliary Coaling Stations; Best Designs, Capacity, and Method of Handling Coal. Brought forward from 1900	W. A. McGonagle, G. W. Smith, E. Fisher, J. P. Snow, B. F. Bond, R. B. Tweedy.

2.

Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expenses for Various Classes of Railroad Buildings	E. Fisher, R. H. Reed, J. S. Berry, J. P. Snow.

3.

Mail Cranes, First Cost, Efficiency and Maintenance of Various Styles in Use	A. S. Markley, F. Price, James Brady, G. W. Smith, D. W. Lum.

4.

Best Method of Protecting Low Overhead Structures Over Tracks from Gases and Blast of Locomotives.	G. W. Andrews, J. S. Lemond, C. M. Large, A. H. King, James T. Carpenter, E. H. R. Green, A. E. Killam.

5.

What has been the Expenses in the Use of Concrete Under Bridge Bedplates and Turn-tables in Place of Pedestal Stones, and What is the Best Form and Material for Bedplates Under Various Styles of Iron Bridges?	W. A. Rogers, Frank W. Tanner, George J. Bishop, J. H. Markley, A. McNab, George E. Hanks.

6.

Best Design and Recent Practice in Building Railroad Track Pile Driver	T. M. Strain, A. W. Merrick, Chas. C. Mallard, A. B. Manning, W. M. Noon, W. T. Powell.

7.

Best Material and Designs for Roundhouse Pits, Including Drainage and Rail Fastings	ArthurMontzheimer, E. M. Gilchrist, J. W. Taylor, James Stannard, Onward Bates.

8.

Best Materials for Wearing Surface of Roadway of Highway Bridge Floors	W. O. Eggleston, B. F. Peckering, A. B. Sheldon, C. P. Austin, Joseph M. Staten, O. J. Travis.

COMMITTEE ON SUBJECTS.

Walter G. Berg, Lehigh Valley Ry., New York City, Chairman.
C. C. Mallard, Southern Pacific Ry., Algiers, La.
J. H. Cummin, Long Island R. R., Long Island City, N. Y.
W. E. Smith, C., M. & St. P. Ry., Greenbay, Wis.
J. D. Isaacs, Southern Pacific Ry., San Francisco, Cal.
C. W. Gooch, 1325 West 9th St., Des Moines, Iowa.
L. F. Goodale, H. & St. J. R. R., St. Joseph, Mo.
W. A. McGonagle, D. & I. R. R. Co., Two Harbors, Minn.

COMMITTEE ON APPLICATION FOR MEMBERSHIP.

A. W. Merrick, C. & N. W. Ry., Huron, S. D., Chairman.
H. D. Cleaveland, P., B. & L. E. R. R., Greenville, Pa.
Chas. Carr, M. C. R. R., Jackson, Mich.

COMMITTEE ON RELIEF.

James Stannard, Wabash R. R., Moberly, Mo., Chairman.
C. W. Vandergrift, C. & O. Ry., Alderson, W. Va.
George J. Bishop, C., R. I. & P. Ry., Topeka, Kansas.
J. Y. Hill, Memphis Division Southern Ry., Tuscumbia, Ala.

COMMITTEE ON ENTERTAINMENT.

W. A. McGonagle, D. & I R. R. Co., Two Harbors, Minn., Chairman.
C. A. Lichty, C. & N. W. Ry., Lake City, Ia.

CONSTITUTION.

ARTICLE I.

NAME.

SECTION 1. This Association is known as the "Association of Railway Superintendents of Bridges and Buildings."

ARTICLE II.

OBJECT.

SECTION 1. The object of this Association shall be the mutual advancement of its members, by the acquirement of more perfect knowledge in the construction, maintenance, and repair of railroad bridges and buildings, as well as all other matters entrusted to the care of superintendents of bridges and buildings, by common discussion, interchange of ideas, reports, and investigations of its members.

ARTICLE III.

MEMBERSHIP.

SECTION 1. Any person at the head of a bridge and building department on any railroad, or a division or subdivision, and to include assistant superintendent and general foreman of any railroad, shall be eligible to membership in this Association upon application to the Secretary and the payment of $3.00 membership fee and $3.00 for one year's dues, membership to continue until written resignation is received by the Secretary, unless member has been previously expelled.

SEC. 2. Any member guilty of dishonorable conduct, or conduct unbecoming a railroad official and member of this Association, or who shall refuse to obey the chairman, or rules of this Association, may be expelled by a two-thirds vote of the members present.

ARTICLE IV.

OFFICERS.

SECTION 1. The officers of this Association shall be a president, four vice-presidents, a secretary, a treasurer, and six executive members. The executive members, together with the president, secretary, and treasurer, shall constitute the Executive Committee.

All Past-Presidents of this Association, who continue to be members, shall be entitled to be present at all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions coming before the Executive Committee and to aid said committee by their advice and counsel; but, said Past-Presidents shall not have a right to vote, nor shall their presence be requisite in order to constitute a quorum.

ARTICLE V.

DUTIES OF OFFICERS.

SECTION 1. The duties of officers shall be such as prescribed by by-laws, as pertain to officers of like character, general, or may be assigned them by the Executive Committee.

ARTICLE VI.

EXECUTIVE COMMITTEE.

SECTION 1. The Executive Committee shall exercise a general supervision over the financial and other interests of the Association, assess the amount of annual and other dues, call, prepare for, and conduct general or special meetings, make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have power to render the Association liable for any debt beyond the amount then in the treasurer's hands not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

SEC. 2. The Executive Committee shall report the proceedings of its meetings, making such reports accessible to members; it shall publish the proceedings of all meetings of the Association, subject to the approval of the Association.

SEC. 3. Two thirds of the members of the Executive Committee may call special meetings, sixty days' notice being given members by mail.

SEC. 4. Five members of the Executive Committee shall constitute a quorum for the transaction of business.

ARTICLE VII.

ELECTION OF OFFICERS AND TENURE OF OFFICE.

SECTION 1. The officers, excepting as otherwise provided, shall be elected at the regular meeting of the Association, held on third Tuesday in October of each year, and the election shall not be postponed except by unanimous consent.

PRESIDENT AND TREASURER.

SEC. 2. The president and treasurer shall be elected by ballot by a majority of votes cast, and shall hold office for one year, or until successors are elected.

VICE-PRESIDENTS AND EXECUTIVE MEMBERS.

SEC. 3. The vice-presidents shall hold office for one year and executive members for two years, four vice-presidents, and three executive members to be elected each year; provided, however, that three of the executive members be appointed by the president at the adoption of this constitution. All officers herein named to hold office until successors are chosen at next annual meeting.

SEC. 4. In the election of vice-presidents, each one shall be elected by a majority vote. Executive members will be elected in the same way, all voting to be by written ballots.

SECRETARY.

SEC. 5. A secretary shall be elected by a majority of the votes of the members present at the annual meeting. The term of office of the secretary shall be for one year, unless terminated sooner by action of the Executive Committee, two-thirds of whom may remove the secretary at any time. His compensation shall be fixed by a majority of the Executive Committee. The secretary shall also be secretary of the Executive Committee.

TREASURER.

SEC. 6. The treasurer shall be required to give bond in an amount to be fixed by the majority of the Executive Committee.

ARTICLE VIII.

COMMITTEES.

SECTION 1. At the first session of the annual meeting the president shall appoint a committee of three members, not then officers of the Association, who shall send names of nominees for officers of the Association for the ensuing year to the secretary, before the election of officers is in order, and the names shall be announced as soon as received. The election shall not be held until the day after announcement, except by unanimous consent. Nothing in this section shall be construed to prevent any members from making nominations.

AUDITING COMMITTEE.

SEC. 2. At the first session of each annual meeting there shall be appointed by the president an auditing committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the treasurer and certify as to the correctness of his accounts. Acceptance of this committee's report will be regarded as the discharge of the committee.

COMMITTEES ON SUBJECTS FOR DISCUSSION.

SEC. 3. At the annual meeting there shall be appointed by the president a committee, whose duty it shall be to prepare and report subjects for discussion and investigation at the next annual meeting. If subjects are approved by the Association, the president shall appoint a committee to report on them. It shall be the duty of the committee to receive from members questions for discussion during the time set apart for that purpose. This committee shall be the judge of whether such questions are suitable ones for discussion, and if so, report them to the Association.

COMMITTEES ON INVESTIGATION.

SEC. 4. When the committee on subjects has reported and the Association approved of the same, the president shall appoint special committees to investigate and report on said subjects and he may appoint a special committee to investigate and report on any subject which a majority of members present may approve of.

ARTICLE IX.

ANNUAL DUES.

SECTION 1. Every member shall pay to the treasurer three dollars membership fee, and shall also pay three dollars per year in advance to defray the necessary expenses of the Association. No member being one year in arrears for dues will be entitled to vote at any election, and any member one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

ARTICLE X.

AMENDMENTS.

SECTION 1. This constitution may be amended at any regular meeting by a two-thirds vote of members present, provided that a written notice of the proposed amendment has been given at least ninety days previous to said regular meeting.

BY-LAWS.

TIME OF MEETING.

1. The regular meeting of this Association shall be held annually on the third Tuesday in October.

HOUR OF MEETING.

2. The regular hour of meeting shall be at 10 o'clock a. m.

PLACE OF MEETING.

3. The cities or places for holding the annual convention may be proposed at any regular meeting of the Association before the final adjournment. The places proposed shall be submitted to a ballot vote of the members of the Association, the city or place receiving a majority of all the votes cast to be declared the place of the next annual meeting; but if no place received a majority of all votes, then the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

QUORUM.

4. At the regular meeting of the Association, fifteen or more members shall constitute a quorum.

ORDER OF BUSINESS.

5. 1st—Calling of roll.
2d—Reading minutes of last meeting.
3d—Admission of new members.

4th—President's address.
5th—Reports of secretary and treasurer.
6th—Payment of annual dues.
7th—Appointment of committees.
8th—Reports of committees.
9th—Unfinished business.
10th—New business.
11th—Reading and discussion of questions propounded by members.
12th—Miscellaneous business.
13th—Election of officers.
14th—Adjournment.

DUTIES OF OFFICERS.

6. It shall be the duty of the president to call the meeting to order at the appointed time; to preside at all meetings; to announce the business before the Association, and to decide all questions of order and sign all orders drawn on the treasurer.

7. It shall be the duty of the vice-presidents, in the absence of the president, to preside at all meetings of the Association, in their order named.

8. It shall be the duty of the secretary to keep a correct record of proceedings of all meetings of this Association; to keep correct all accounts between this Association and its members; collect all moneys due the Association, and pay the same over to the treasurer and take his receipt therefor, and to perform such other duties as the Association may require.

9. It shall be the duty of the treasurer to receive and receipt to the secretary for all moneys received from him, and pay all orders authorized by the Association.

DECISIONS.

10. The votes of a majority of members present shall decide any question, motion, or resolution which shall be brought before the Association, unless otherwise provided.

DISCUSSIONS.

11. All discussions shall be governed by Roberts' Rules of Order.

DIRECTORY OF MEMBERS.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

OCTOBER, 1901.

ALEXANDER, W. E., Bangor & Aroostook R. R., Houlton, Maine.
ANDERSON, J. W., Cin., Hamilton & Dayton Ry., Chillicothe, Ohio.
ANDREWS, GEORGE W., Philadelphia Div. B. & O. R. R., Baltimore, Md., 1632 Hollins St.
ANDREWS, O. H., St. Jo. & G. I. & K. C. Ry., St. Joseph, Mo.
AUSTIN, CYRUS P., B. & M. R. R., Medford, Mass.
AUSTIN, A. J., M.. K. & T. Ry., St. Louis, Mo.
BATES, ONWARD, C. E., 1203 Manhattan Building, Chicago, Ill.
BANKS, JOHN I., Chicago Great Western Ry., St. Paul, Minn.
BARRINGTON, EDWARD, National Tehuantepec Ry., P. O. Pox 2015, City of Mexico.
BEAHAM, WILLARD, C. & N. W. Ry., Winona, Minn.
BELL, W. E., Plant System, Thomasville, Ga.
BERG, WALTER G., Lehigh Valley Ry., 261 West 52d St., New York City.
BERRY, J. S., S. T. S. W. Ry., Tyler, Texas.
BERRY, WILLIAM, San Antonia & Arkansas Pass Ry., Yoakum, Texas.
BISHOP, GEORGE J., C., R. I. & P. Ry., Topeka, Kan.
BLODGETT, A. S., K. C., F. S. & M. Ry., Kansas City, Mo.
BOND, B. F., Jacksonville & St. Louis Ry., Jacksonville, Ill.
BRADY, JAMES, Chicago, Rock Island & Pacific Ry., Davenport, Ia.
BRUCE, ROBERT J., P., C., C. & St. L. Ry., Logansport, Ind.
CALDWELL, J. M., Chicago, Ind. & Louisville R. R., Lafayette, Ind.
CANTY, JOHN P , Fitchburg Div. B. & M. R. R., Fitchburg, Mass.
COOPER, A. R., 4th Div. Plant System, Montgomery, Ala.
CARR, A. C., L. & N. R. R., Middleboro, Ky.
CARR, CHARLES, Michigan Central R. R., Jackson, Mich.
CARMICHAEL, WILLIAM, U. Pac. R. R., 627 Franklin Ave., Kansas City, Kan.
CARPENTER, JAMES T., L. E. & St. L. R. R., Princeton, Ind.
CAUSEY, T. A., 706 2d St., Ft. Scott, Kan.
CLARK, WILLIAM M., Pittsburg & Western Ry., Etna, Alleghany Co., Pa.
CLEAVELAND, H. D., Pittsburg, Bessemer & Lake Erie R. R., Greenville, Pa.
COLBURN, D. K., Atlantic System, Southern Pacific Ry., Houston, Texas.
CUMMIN, JOSEPH H., Long Island R. R , Long Island City, N. Y.
DANES, WILLIAM S., Wabash R. R., Eastern Div., 102 Ewing St., Peru, Ind.
DARRACOTT, T. J., Plant System, Lakeland, Ga.
DAVIS, CHARLES HENRY, Barclay R. R., 99 Cedar St., N. Y. City.
DODSON, J. A., Southern Railway, Greensboro, N. C.

EDINGER, FRED S., Pacific System, Southern Pacific Ry., San Francisco, Cal.
EGGLESTON, WILLIAM O., C. & Erie R. R., Huntington, Ind.
EGGLESTON, H. H., C., C., C. & St. L. Ry., Union City, Ind.
EILERS, FRED, Chicago, Burlington & Quincy R. R., Ottumwa, Ia.
ENNES, I. R., South Carolina & Georgia R. R., Branchville, S. C.
EVANS, I. W., Southern Ry., Birmingham, Ala.
FISHER, E., Missouri Pacific Ry., Pacific, Mo.
FLETCHER, HOLLAND W., 2366 California Ave., Alleghany, Pa.
FLINT, C. F., Central Vt. R. R., St. Albans, Vt.
FOREMAN, JOHN, Phila. & Read. R. R., Pottstown, Pa.
FORT, WILLIAM A., Southern Ry., Columbia, S. C.
GARRISON, I., Chesapeake & Ohio Ry., 2200 East Marshal St., Richmond, Va.
GILBERT, JAMES D., G. C. & S. F. Ry., Cleburne, Tex., Box 4.
GILCHRIST, ED. M., Hannibal & St. Joseph R. R., Brookfield, Mo.
GOOCH, C. W., 1325 West 9th St., Des Moines, Ia.
GOODALE, L. F., Hannibal & St Joseph R. R., room 610, Globe-Democrat Building, St. Louis, Mo.
GOLDMARK, HENRY, 1731 Monadnock Block, Chicago, Ill.
GREEN, E. H. R., Texas Midland R. R., Terrell, Texas.
GREINER, J. E., B. & O. R. R , Baltimore, Md.
GUILL, B. A., Georgia R. R., Camok, Ga.
GUPPY, B. W., Maine Central R. R., Portland, Me.
HAIN, J. C., Engr. Per. Con., C., M. & St. P. Ry., Chicago, Ill.
HANKS, GEORGE E., Flint & Pere Marquette Ry., East Saginaw, Mich.
HARVEY, JAMES R., St. L., I. M. & S. Ry., Little Rock, Ark.
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2. Best snow fence, stationary or portable.
3. Best method of erecting track scales, suspended or under track.
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PROCEEDINGS

OF THE

TWELFTH ANNUAL CONVENTION

OF THE

Association of Railway Superintendents of Bridges and Buildings,

HELD IN

MINNEAPOLIS, MINN.,

OCTOBER 21, 22, AND 23, 1902.

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A. C. Macy, C., S. W. Ry., St. Paul, Minn.
J. E. Greiner, B. & O. Ry., Baltimore, Md.

2. Should ties of bridges be gained so as to leave rail without camber, or should only a portion of camber be taken out?

R. H. Reid, L. S. & M. S. Ry., Cleveland, O., Chairman.
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H. D. Cleaveland, P., B. & L. E. Ry., Greenville, Pa.
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J. E. Johnson, N. Y. C. & H. R. Ry., New York, N. Y.
G. W. McGehee, M. & O. Ry., Okolona, Miss.

3. In case one arm of an important metal drawbridge over a deep stream should be wrecked, what is the most expeditious way to restore railway and water traffic?

John D. Isaacs, So. Pacific Ry., San Francisco, Cal., Chairman.
F. E. Schall, Lehigh Valley Ry., South Bethlehem, Pa.
Geo. C. Nutting, O. R. & C. R. R., Blacksburg, S. C.
W. M. Noon, D., S. S. & A. Ry., Marquette, Mich.
A. McNab, Pere Marquette Ry., Holland, Mich.
Geo. W. Andrews, B. & O. Ry., Baltimore, Md.

4. What is the best form of traveler to use in erecting steel railway bridges of spans up to 200 feet?

G. W. Smith, American Bridge Co., 13 Monadnock Blk., Chicago, Ill., Chairman.
O. J. Travis, Ill. Central Ry., Chicago, Ill.
J. P. Snow, B. & M. Ry., Boston, Mass.
C. W. Kelley, C. & N. W. Ry., Boone, Ia.
Joseph M. Staten, C. & O. Ry., Richmond, Va.
F. W. Tanner, Mo. Pacific Ry., Atchison, Kan.

5. Best method of protecting solid steel floors of bridges.

A. O. Cunningham, Wabash Ry., Lincoln Trust Bldg., St. Louis, Mo., Chairman.
Geo. F. Powers, C., L. S. & E. Ry., Joliet, Ill.
D. W. Lum, Southern Ry., Washington, D. C.
Albert C. Keith, M. C. & Ft. Dodge Ry., Ft. Dodge, Ia.

C. P. Austin, B. & M. Ry., Lawrence, Mass.
F. E. Schall, Lehigh Valley Ry., South Bethlehem, Pa.

6. Best plans for small tool houses, including switchmen's and car repairers' shanties, and section, tool, and hand-car houses.

J. B. Sheldon, N. Y., N. H. & H. Ry., Providence, R. I., Chairman.
H. E. Holmes, C. V. Ry., New London, Conn.
W. E. Bell, Plant System, Thomasville, Ga.
Geo. Mitchell, G. T. Ry., Durand, Mich.
Ed. Gagnon, M. & St. L. Ry., Minneapolis, Minn.
C. R. Walton, Southern Ry., Asheville, N. C.

7. Best practical sanitary arrangements for small stations where there are no water or sewer systems.

J. H. Markley, T., P. & W. Ry., Peoria, Ill., Chairman.
F. J. Leavitt, B. & M. Ry., Sanbornville, N. H.
Geo. J. Patterson, C. V. Ry., Waterbury, Vt.
E. B. Ashby, Lehigh Valley Ry., So. Bethlehem, Pa.
T. J. Darracott, Plant System, Lakeland, Ga.
A. W. Merrick, C. & N. W. Ry., Eagle Grove, Ia.

8. Best method of making annual inspection of bridges and culverts, and form of report to be made.

Walter G. Berg, Lehigh Valley Ry., 261 West 52d St., New York, N. Y., Chairman.
J. A. Dodson, Southern Ry., Washington, D. C.
C. F. Loweth, C., M. & St. P. Ry., Chicago, Ill.
Arthur Montzheimer, C. & N. W. Ry., Milwaukee, Wis.
A. Zimmerman, C. & S. Ry., Denver, Col.
A. Shane, T., St. L. & K. C. Ry., Frankfort, Ind.

9. Water filters, or other methods of purifying water for engine use.

R. C. Sattley, C. & N. W. Ry., Chicago, Ill., Chairman.
J. E. Greiner, B. & O. Ry., Baltimore, Md.
Ed. M. Gilchrist, H. & St. J. Ry., Brookfield, Mo.
Geo. E. Hanks, F. & P. M. Ry., East Saginaw, Mich.
A. B. Manning, M., K. & T. Ry., Parsons, Kan.
James Rogers, N. Y. C. & St. L. Ry., Fort Wayne, Ind.
C. W. Kelley, C. & N. W. Ry., Boone, Ia.

10. Best method of storing fuel oil, with appliances for supplying locomotives, including plan of water stations, showing relative arrangements of fuel and water supply.

C. C. Mallard, So. Pacific Ry., Algiers, La., Chairman.
J. S. Berry, S. T. S. W. Ry., Tyler, Tex.
Geo. J. Bishop, C., R. I. & P. Ry., Topeka, Kan.
William Carmichael, U. P. Ry., 627 Franklin Ave., Kansas City, Kan.
W. M. Clark, P. & W. Ry., Etna, Pa.
I. W. Evans, Southern Ry., Birmingham, Ala.
E. Fisher, Mo. Pacific Ry., Pacific, Mo.

11. What has been the experience in the use of concrete under bridge bed-plates and turn-tables in place of pedestal stones, and what is the best form and material for bed-plates under various styles of iron bridges.

J. C. Hain, Engr. Per Con. C., M. & St. P. Ry., Chicago, Ill., Chairman.
Walter A. Rogers, C. E., 1203 Manhattan Bldg., Chicago, Ill.
A. Minster, C., G. W. Ry., St. Paul, Minn.
L. F. Goodale, H. & St. J. Ry., room 610 Globe Democrat Bldg., St. Louis, Mo.
E. H. Green, Tex. Midland, Terrell, Tex.
J. C. Hain, C., M. & St. P. Ry., Chicago, Ill.
E. P. Hawkins, M. & O. Ry., Okolona, Miss.

COMMITTEE ON SELECTION OF SUBJECTS.

J. H. Cummin, Long Island Ry., Long Island City, N. Y., Chairman.
W. A. McGonagle, D., M. & N. R. R, Duluth, Minn.
J. S. Lemond, Southern Ry., Atlanta, Ga.
W. E. Smith, C., M. & St. P. Ry., 1730 Fulton St., Chicago, Ill.
J. D. Isaacs, So. Pacific Ry., San Francisco, Cal.
C. W. Vandergrift, C. & O. Ry., Alderson, W. Va.
P. N. Watson, M. C. Ry., Brunswick, Me.
D. C. Zook, Penn. Lines W. of Pittsburg, Ft. Wayne, Ind.

COMMITTEE ON APPLICATIONS FOR MEMBERSHIP.

A. S. Markley, C. & E. I. Ry., Danville, Ill., Chairman.
W. S. Danes, Wabash Ry., 102 Ewing St., Peru, Ind.
Geo. E. Hanks, F. & P. M. Ry., East Saginaw, Mich.
C. M. Large, E. & P. Ry., Jamestown, Pa.

COMMITTEE ON SOLICITING NEW MEMBERS.

C. A. Lichty, C. & N. W. Ry., Fond du Lac, Wis., Chairman.
A. A. Page, B. & M. Ry., Boston, Mass.
H. C. Rettinghouse, C. & N. W. Ry., Kaukauna, Wis.
W. O. Eggleston, Erie Ry., Jersey City, N. J.
J. W. Lovett, Southern Ry., Atlanta, Ga.
A. Zimmerman, C. & S. Ry., Denver, Col.

COMMITTEE ON RELIEF.

James Stannard, Wabash Ry., Moberly, Mo., Chairman.
M. Riney, C. & N. W. Ry., Baraboo, Wis.
J. W. Morgan, Southern Ry., Columbia, S. C.
A. Mountfort, B. & M. Ry., Nashua, N. H.
F. S. Edinger, So. Pacific Ry., San Francisco, Cal.
Edward Barrington, Tierra Blanca, Vera Cruz, Mexico.

COMMITTEE ON ENTERTAINMENT.

A. E. Killam, Intercolonial Ry., Moncton, N. B., Chairman.
W. E. Alexander, B. & A. Ry., Houlton, Me.

COMMITTEE ON MEMOIRS.

W. G. Berg, Ch. Eng. L. V. R. R., New York City.

PROCEEDINGS OF THE TWELFTH ANNUAL CONVENTION

OF THE

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

HELD IN MINNEAPOLIS, MINNESOTA, OCTOBER 21, 22, AND 23, 1902.

MORNING SESSION.

TUESDAY, October 21, 1902.

The Convention was called to order by the president, Mr. W. S. Danes, at 10:20 o'clock a. m., Tuesday, October 21, 1902, in the club room of the West Hotel, Minneapolis, Minnesota.

President.—I will ask our esteemed member, Mr. J. H. Cummin, to offer prayer.

Prayer was offered by Mr. Cummin.

President.—Ladies and Gentlemen, I take pleasure in introducing to you Mayor Jones of Minneapolis, who will now address us.

Mayor Jones.—Mr. President, and Members of the Association of Railway Superintendents of Bridges and Buildings: It gives me, in my representative capacity, very great pleasure to stand here this morning and give you a very hearty welcome to Minneapolis. A year ago, I understand you met in the Sunny South, and that the people of Georgia gave you a very cordial and hearty welcome, and now as the term of twelve months comes around again, you are to hold your annual meeting, and I am very happy to have you hold it here in Minneapolis, in the Northwest. We are very proud to have such a distinguished gathering meet with us in national convention. You represent something very definite in the American life

because you represent a vast army of industrial workers whose very life and existence means immensely for the benefit of these United States. We, in the Northwest, really very much appreciate what the railroads are doing in this country; we are not like some of the Eastern states, the place where the railroads were incorporated and first began their corporate life. It has only been a very few years since the railroads began to span the Minnesota frontier, and to start out in one direction and another, bringing us in close contact with the rest of the country, and we especially appreciate what the railroads are doing for us here in the Northwest, and particularly for the Minnesota Twin Cities.

This railroad development is very significant, it has a great deal to do with the prosperity in this country; without the railroads we could, literally, do very little, but we can now grasp hands with the people of the two Dakotas, Montana, and Washington. A few years ago it used to be considered almost impossible for anybody in Minnesota to get across the Rocky Mountains and find himself on the Pacific coast, but what a simple thing it is to-day. Now, Mr. President, in a general way, you represent in your Convention here the railroads of the country, but more technically and directly, you represent, as I understand it, sir, that department which has to do with the construction of the railroads and the construction of buildings, which represents brains, hard work, and a very superior grade of intelligence. I remember, as a very young lad, of standing with my hand in my father's on a bridge at Bristol, England, which is one of the highest in the world, something over two hundred feet above the water, and I was so immensely impressed that I made a vow that I would build bridges. What boy has not in his heart of hearts, said that he would build a locomotive, or that he would build a great bridge? There is something about it mighty attractive, and that is why so many men of culture, intelligence, and technical knowledge and skill have joined the ranks of those who have to do with this kind of work.

I can say very little more except to make my welcome to you brief and hearty, and to say that it is also particularly pleas-

ing to see the ladies here with you this morning, and it is a very happy privilege to welcome them as well as yourselves. Minneapolis loves to be hospitable, and we do not wish to have it understood that the latch-string is not always out in Minneapolis. The town is open to you, and I trust that the local committee on entertainment have made it perfectly evident that it is our desire that your stay here will be a happy one, and I wish simply to say, "Come in, make yourself at home, and stay as long as you can," and in behalf of Minneapolis I bid you a most hospitable welcome and ask you to enjoy to the full everything we can offer you while here. I thank you. (Applause.)

President.—In behalf of the Association I will ask Mr. Cummin to respond.

Mr. Cummin.—Mayor Jones, in behalf of the Association of Railway Superintendents of Bridges and Buildings, and Ladies: I hardly know how to express myself in replying to the earnest and kindly greeting with which you have welcomed us to your beautiful city. We are simply railroad men, a comparatively small association in comparison with some of the larger railroad associations with which you have probably met at times previous, but we do believe in our own hearts that we have a membership that is as fully devoted to their calling as any association connected with the railroads of America. We meet year by year, not only to gain knowledge ourselves, but we feel proud that we have a number among our members who are as able to dispense knowledge to us as the rest of us are to receive it. I am glad you mentioned in your remarks the presence of the ladies with us, because we always feel proud to have them with us, and while we do not in any way claim to be a temperance association, yet I think we do claim to be temperate and I think one of the grandest tributes ever paid to our membership was given by the proprietor of a hotel at which we held our convention several years ago. After the meeting was over several of us stepped up to the desk to square our accounts, and the proprietor came up and said, "Well, boys, you are going to leave us?" and we said, "Yes, sir, our meeting is over and we have to go back home."

"Well," said he, "before you go away, I want to tell you one thing. I have been in the hotel business over thirty years, and have had associations and conventions of all kinds meet at my house, but in my thirty years' experience, I have never had a body of men who behaved themselves better and patronized my bar less than the membership of your Association has." (Applause.) And I think that a great deal of the credit for that should be given to the ladies. I think that every member of this Association can fully agree with the Irishman who was called upon suddenly at a banquet to respond to the toast "Women." He got up, somewhat embarrassed, and looked over the audience and said, "The women, God bless them, if it wasn't for them not one of us would be here." (Laughter)

Numerous changes and improvements have taken place in railroading during the past few years, as in everything else, as I presume you are aware.

In the old time railroading which a great many of us, especially some of these white-haired friends of mine, can remember, the man who could swear the loudest and the longest was considered the best man for an official. Nowadays the railroads are not looking for that class of men, and they fully appreciate the idea of training and bringing their men up to lead better lives, which is evidenced, as you will notice, by the large number of railroad branches of the Y. M. C. A. that are scattered all over the land. We have one on the road that I represent. Nine years ago when a train came into Long Island city, just as soon as the boys registered, it was impossible to trace or know where to find a crew. There wasn't a place in Long Island city excepting a saloon to go to. We have now a four-story building fitted up with all the conveniences, dining-room, kitchen, twenty bedrooms, etc., and a library of over six hundred volumes, and to-day if the trainmaster wants to pick up a crew in a hurry, it does not take five minutes to find them. While I am speaking about the Y. M. C. A., I don't want you to think that it is necessary for a man to be a Christian to become a member of the Y. M. C. A. It makes no difference about country, sect, or opinion, they are eligible for membership; but the way the boys are trained there at the

present time, I believe every one of them are as near to it as the Hebrew lawyer of whom Senator Depew spoke at a dinner that was given to Mr. Choate just prior to his departure for England. He said that Mr. Choate had been retained by a large railroad corporation on a case in which a large amount of money was involved. In looking into the details of the case he found one particular point of law which it was very necessary should be brought out, and upon investigating the matter, he found a certain Hebrew lawyer was the best posted man on that point. He sent for him and explained the case to him, and told him that the case was to come up in two days, and he wanted him to prepare himself for it. The case came up and when the proper time came, the Hebrew lawyer summed up with such effect that the railroad company received a verdict in their favor.

Mr. Choate was highly elated and as they were going out of the court room said: "Mr. Isaacs, you have virtually won that case for us, and I am going to let you name your own fee." The lawyer thought a moment, and said: "Well, Mr. Choate, I think we should get one thousand dollars for that case, five hundred dollars for you and five hundred for me. I worked two whole days on that case, and that is only two hundred and fifty dollars a day." Mr. Choate replied, "You better leave that with me!"

A few days later he received a check for twenty-five hundred dollars; when he looked at it he was amazed and immediately started for Mr. Choate's office, and said: "Mr. Choate, what does this mean, twenty-five hundred dollars, that is enormous, and on that case only two days, and twenty-five hundred dollars for you and twenty-five hundred dollars for me." Mr. Choate assured him that it was correct, and he replied, "Mr. Choate! Oh, Mr. Choate! Almost thou persuadest me to become a Christian." (Laughter.)

I understand from your remarks, Mr. Mayor, that we are visiting the Twin Cities, and from what I have been able to see, you are still on the path of progress, and I am glad to know that you are not in the same condition as a young woman of whom I heard. After she had been married some time she

presented her husband with a pair of twins. It was an unusual event in the family and the neighbors called in, and were giving a lot of advice as to what their names should be. The young woman spoke up and said: "You need not worry about it, I have already settled it. I am going to call them Kate and Duplicate." It went on for some time, when she presented her husband with another pair of twins, the same conversation ensued, and she said: "You need not worry about it." And they said, "Well, what in the world are you going to name them this time?" and she replied, "Peter and Repeater." Sometime afterwards another pair came, the same conversation ensued, and she stated that it was all settled, and they said, "Well, what in the world are you going to call them now?" She said: "Max and Climax." (Laughter.) I sincerely trust that the Twin Cities have not arrived at the climax of their prosperity yet.

President.—Ladies and Gentlemen, I now wish to introduce Mr. W. G. Nye, chairman of the Convention Committee of the Commercial club of Minneapolis.

Mr. Nye.—Mr. President, Ladies, and Gentlemen: I am sure I do not need to add a word to what our mayor has said to assure you of a welcome to our city. However, as chairman of the Convention Committee of our Commercial club it has been my duty and pleasure during the past season to show visiting delegations to our city such entertainment and such evidence of welcome as lies within our power. Our Commercial club, comprising one thousand of the business and professional men of the city, is organized not only for the social welfare of its members, but to promote in every way that it can, the highest public good of our city. Every member of our organization is proud of our city, proud of its remarkable growth and of the present metropolitan position that it occupies among the cities of the country, and we are always pleased to have delegations come and visit our city, and to show them the points of interest in and about Minneapolis. It has been my pleasure during the past summer to welcome a good many delegations to Minneapolis, and to extend to them the hospitalities of our club, and especially am I pleased this morning

to come before you as the representative of our Commercial club and offer you the privileges of its club-rooms whenever you can find opportunity to use them during your stay here. I beg to say that we have arranged some features of entertainment for you, and that we have endeavored to so plan such entertainment as we have to give that it does not conflict with any features of your regular programme. To-morrow afternoon carriages will be at hand to give you a drive through the business section of the city, and to the large flouring mills, thence down along the bank of the Father of Waters to the government dam which "Uncle Sam" is constructing a few miles below where you now sit. Wednesday night we have taken pleasure in reserving seats for you at the Metropolitan theater, where De Wolfe Hopper is giving one of the most enjoyable plays that has ever come to our city. Thursday afternoon, again, if the weather is favorable, arrangements will be made for a drive about the city, or for a trolley ride, as your entertainment committee may elect. I am sure that I voice the sentiment of every member of our organization when I bid you a cordial welcome, and express the hope that your stay in our city will be enjoyable to you, and that the sessions of your Association will prove valuable to you in your important calling. I thank you. (Applause.)

President.—In behalf of the members I wish to thank Mr. Nye for the remarks made to the Convention. Mr. Cummin responded to Mayor Jones. The next order of business will be the roll-call, Mr. Secretary.

Mr. Cummin.—Mr. President, perhaps the ladies who are present would not care to remain for the roll-call; it may not interest them, and I would suggest that the badges be distributed before the roll is called, and I would also like to say that I think we should present the Mayor and Mr. Nye with one of them, as a slight souvenir of our visit.

President.—I will appoint Mr. Cummin, a committee of one to distribute the badges.

A recess was then taken for the distribution of the badges, etc.

President.—The meeting will please come to order. The

next order of business is calling the roll, but before that Mr. McGonagle wishes to make some remarks.

Mr. McGonagle.—While the roll is being called it will be a great advantage to the local Committee on Arrangements if each member will arise and respond to his name, and at the same time state whether he will or will not make the trip to Duluth; if he will make it, state how many ladies will accompany him on that trip. This information is necessary at this time in order to permit arrangements to be made with the Pullman company for sleeping car accommodations.

President.—We will now proceed with the roll-call, and would like to ask the members to comply with the request of Mr. McGonagle.

Secretary Patterson then called the roll and the following members responded:

ROLL-CALL.

PRESENT.

ALEXANDER, W. E., B. & A. R. R., Houlton, Me.
AUSTIN, C. P., B. & M. R. R., Medford, Mass.
CANTY, JOHN P., B. & M. R. R., Fitchburg, Mass.
CLEAVELAND, H. D., P. B. & L. E. R. R., Greenville, Pa.
CUMMIN, J. H., L. I. R. R., Long Island City, N. Y.
DANES, W. S., Wabash R. R., Peru, Ind.
FLETCHER, H. W., Alleghany, Pa.
HAIN, J. C., C., M. & St. P. Ry., Chicago, Ill.
KILLAM, A. E., Intercolonial Ry., Moncton, N. B.
LARGE, C. M., E. & P. Ry., Jamestown, Pa.
LEAKE, THOMAS S., Ill. Cent. R. R., Chicago, Ill.
LEMMOND, J. S., Southern Ry., Atlanta, Ga.
LICHTY, C. A., C. & N. W. Ry., Fond Du Lac, Wis.
LOVETT, J. W., Southern Ry., Atlanta, Ga.
LOWETH, C. F., C., M. St. P. Ry., Chicago, Ill.
MARKLEY, A. S., C. & E. I. Ry., Danville, Ill.
MARKLEY, JOHN H., T., P. & W. Ry., Peoria, Ill.
MALLARD, C. C., So. Pac. Ry., Algiers, La.
McGONAGLE, W. A., D., M. & N. Ry., Duluth, Minn.
McIVERS, B. T., St. P. & D. Ry., St. Paul, Minn.
McINTYRE, JAMES, Erie R. R., Cleveland, O.

McGehee, G. W., M. & O. R. R. Okolona, Miss.
Montzheimer, A., C. & N. W. Ry., Milwaukee, Wis.
Noon, W. M., D., S. S. & A. Ry., Marquette, Mich.
Patterson, S. F., B & M. R. R., Concord, N. H.
Pickering, B. F., B. & M. R. R., Sanbornville, N. H.
Powers, Geo. F., C., L. S. & E. Ry., Joliet, Ill.
Reid, R. H., L. S. & M. S. Ry., Cleveland, O.
Rettinghouse, H., C. & N. W. Ry., Kaukauna, Wis.
Riney, M., C. & N. W. Ry., Baraboo, Wis.
Schall, F. E., L. V. R. R., So. Bethlehem, Pa.
Sheldon, J. B., N. Y., N. H. & H. R. R., Providence, R. I.
Smith, Gilman W., Am. Bridge Co., Chicago, Ill.
Smith, W. E., C., M. & St. P. Ry., Chicago, Ill.
Stannard, James, Wabash R. R., Moberly, Mo.
Staten, Joseph M., C. & O. Ry., Richmond, Va.
Thorn, J. O., C., B. & Q. R. R., Beardstown, Ill.
Thompson, N. W., P., F. W. & C. Ry , Ft. Wayne, Ind.

The following applicants for membership, subsequently elected, were also present:

A. O. Cunningham, Wabash R. R., St. Louis, Mo.
R. C. Sattley, C. & N. W. Ry., Chicago, Ill.
Elbert C. Macy, C. G. W. Ry., St. Paul, Minn.
A. Amos, Minn., St. P. & Sault. Ste M. Ry., Minneapolis, Minn.
Louis Yager, Nor. Pac. Ry., Minneapolis, Minn.
F. Ingalls, Nor. Pac. Ry., Jamestown, N. D.
John Schwartz, C., St. P., M. & O. Ry., Emerson, Neb.
Ed. Gagnon, Minn. & St. L. R. R., Minneapolis, Minn.
Adolph, Yappen, C., M. & St. P. Ry., Milwaukee, Wis.
I. W. McCormack, C., St. P., M. & O. Ry., Altoona, Wis.
D. C. Zook, Penn. Lines West of Pitts., Ft. Wayne, Ind.
A. J. Hart, C., M. & St. P. Ry., Minneapolis, Minn.
C. W. Kelley, C. & N. W. Ry., Boone, Ia.
G. Larson, C., St. P., M. & O. Ry., Itasca, Wis.

President.—Before we go any further I will appoint Mr. B. F. Pickering assistant secretary.

President.—The next order of business will be the reading of the minutes.

Mr. Cummin.—As our minutes have been published and been in the hands of the members for a good many months, I move that the reading of the minutes of the last meeting be dispensed with, and that they be approved as printed.

Mr. Stannard.—I second that motion.

President.—All those in favor of this motion please say Aye. Those opposed, Nay. The Ayes have it.

President.—I would like to ask if the Committee is ready to make their report on new membership.

Mr. Cleaveland.—As the chairman is not here I will make the report of the Committee on Applications for Membership.

Report of the Committee on Applications for Membership read by Mr. Cleaveland.

REPORT OF COMMITTEE ON APPLICATIONS.

The following applicants are recommended for membership in the Association:

I. O. WALKER, Assistant Engineer, Nashville, Chattanooga & St. Louis Ry., Paducah, Ky.

L. P. DESILETE, Bridge Supervisor, Chicago & Great Western Ry., Des Moines, Iowa.

A. F. MILLER, Master Carpenter, Pennsylvania Lines West of Pittsburg, 38 W. Van Buren St., Chicago, Ill.

D. C. ZOOK, Master Carpenter, Pennsylvania Lines West of Pittsburg, Fort Wayne, Ind.

G. H. SOLES, Superintendent Bridges and Buildings, Pittsburg & Lake Erie R. R., Pittsburg, Pa.

GEO. A. MITCHELL, Master Bridges and Buildings, Grand Trunk Ry., Durand, Mich.

E. B. ASHBY, Engineer M. of W., L. V. R. R., So. Bethlehem, Pa.

W. C. WAGGENER, Supervisor Bridges and Buildings, Illinois Central R. R., Central City, Ill.

A. O. CUNNINGHAM, Bridge Engineer, Wabash R. R., St. Louis, Mo.

R. C. SATTLEY, Superintendent Bridges and Buildings, Chicago & N. W. Ry., Chicago.

ELBERT C. MACY, Assistant Engineer, Chicago & Great Western Ry., St. Paul, Minn.

A. AMOS, Superintendent Bridges and Buildings, Minn. & St. Paul & Sault Ste M. Ry., Minneapolis, Minn.

LOUIS YAGER, Master Carpenter, N. P. Ry., Minneapolis.

F. INGALLS, N. P. Ry., Jamestown, N. D.

C. A. PIGFORD, Mobile & Bayshore R. R., Coden, Ala.

JOHN SCHWARTZ, C., St. P., M. & O., Emerson, Neb.

A. J. HART, District Carpenter, C., M. & St. Paul Ry., Minneapolis, Minn.

FRANK J. LEAVITT, General Foreman, Boston & Maine, Sanbornville, N. H.

B. J. SWEATT, Superintendent Bridges and Buildings and Directing Engineer, Chicago & North Western Ry., Mason City, Iowa.

C. W. KELLY, Superintendent Bridges and Buildings, Chicago & North Western Ry., Boone, Iowa.

ED. GAGNON, Superintendent Bridges and Buildings, Minn. & St. Louis R. R., Minneapolis, Minn.

J. JOHNSTON, Superintendent Bridges and Buildings, Northern Pacific Ry., East Grand Forks, Minn.

F. GLASGOW, Superintendent Bridges and Buildings, Chicago, St. Paul, Minn. & Omaha Ry.

ADOLPH YAPPEN, District Carpenter, C., M. & St. P. Ry., Milwaukee, Wis.

J. W. MCCORMICK, Superintendent Bridges and Buildings, C., St. P., Minn. & Omaha Ry., Altoona, Wis.

A. DILLON, Supervisor Bridges and Buildings, Illinois Central R. R., Cherokee, Iowa.

A. MINSTER, Bridge Engineer, Chicago & Great Western Ry., St. Paul, Minn.

J. G. KANE, Superintendent Bridges and Buildings, Chicago & Great Western Ry., Dubuque, Iowa.

G. LARSON, Superintendent Bridges and Buildings, Chicago, St. Paul, Minn. & Omaha Ry., Itasca, Wis.

A. W. MERRICK,
H. D. CLEAVELAND,
CHAS. CARR,
Committee on Applications.

President.—Gentlemen, what shall we do with the report?

Mr. Cummin.—If the chairman of the Committee on Applications for Membership recommends these names, I would move that the secretary cast one ballot for them.

Motion seconded.

President.—It has been moved and seconded that the secretary cast one ballot for the twenty-nine new members proposed for membership. All those in favor of that motion will please signify by saying Aye; opposed, Nay. The Ayes have it, the motion prevails, and the secretary is so instructed.

Secretary.—Mr. President, I cast the ballot as directed.

President.—The secretary having complied with the motion, I declare the twenty-nine gentlemen duly elected members of

this Association. I will give an intermission of five minutes, and would like to have the new members come forward and shake hands and get acquainted with the old members of the Association.

Mr. Cummin.—While the new members are coming forward, I would recommend that the secretary invest them with the usual badge of membership of this Association so that they will feel at home.

President.—We will also take advantage of this intermission for the old members to pay their dues to the secretary.

Thereupon a recess was taken for the introduction of the new members and payment of the annual dues by the old members, after which meeting was again called to order and the president delivered his annual address.

President.—Ladies and Gentlemen, Members of the Association of Railway Superintendents of Bridges and Buildings: We should experience feelings of pleasure and gratification at our meeting in this beautiful city of Minneapolis, in this, our Twelfth Annual Convention. We can congratulate ourselves upon having had a good increase in our membership, and upon being in good condition financially.

It is gratifying to see that our membership is increasing so rapidly, and that the members take such an interest in the work. The year 1902 has been a very busy year with most of us, and it is during busy years that the work of the Association should be of most value. We have with us, to-day, men who stand high in our profession, who have had most valuable experience in all kinds and grades of work.

Though our meeting gives each and every member of this Association an opportunity to discuss the various subjects offered pertaining to our particular branches of work and of the results of carefully-studied and worked-out methods in our branch of railroad and construction work, it becomes necessary to involve different methods of doing work, according to the location. Our publications should become the text-books for construction work, and should be kept easy of access to those who strive to know what is considered good practice, and

endeavor to conduct their business upon intelligent, systematic, and economical lines.

The growth and success of our Association must be dependent upon the nourishment and support that it obtains through the coöperation and interest of its members, and by the gratifying attendance upon its meetings, and by the interest shown in its discussions and publications. The branch of work which comes under the bridge superintendents of this Association is of such a nature that it requires the most careful and diligent watching and inspection, as there has been a great increase in the weight of locomotives and rolling stock during the past few years, which makes it necessary to increase the strength and carrying capacity of our bridges.

I think our Association is of great benefit, as it gives the members of this Association an opportunity of meeting annually and comparing notes, discussing questions, and imparting information, so that each member may go away with all of the information and instruction which the others have acquired during the previous year. The Association is an important school in advancing railway bridge and building men in both the art and science along the lines of their work in the way of safety, security, and success in railway building and in railway management and operation.

It is, of course, true that work in some places cannot be done as speedily and economically as others, as conditions vary on different roads, due to physical climate or traffic characteristics, but the consideration of this question along these lines will be beneficial and educational.

During the year three of our members were taken away. Mr. J. W. Taylor, chief engineer of the Terminal Railway Association of St. Louis, Mo., was killed in an accident; also Mr. J. A. Spangler, of the Baltimore & Ohio Railway, killed in an accident, and Mr. S. S. Millener, of the Baltimore & Ohio Southwest R. R., was taken away by sickness.

During the year the proceedings of the meeting held in Atlanta have been published and distributed, and are a credit to our Association, particularly to our faithful secretary, under whose supervision they have been edited.

I want to thank the Committee on Entertainment for the efficient service they have done in making arrangements for the Convention.

I want to thank the chairman and members of the various committees for their work during the past year, and I want to thank you all for the honor you have bestowed upon me and the kindness extended to me.

President.—The next order of business is the annual report of the secretary.

The annual report of Secretary Patterson was thereupon read by himself.

REPORT OF SECRETARY.

To the Association of Railway Superintendents of Bridges and Buildings:

GENTLEMEN: Your secretary submits the following report for the year ending October 21, 1902. The Executive Committee have met three times since the adjournment of the last Convention, giving general directions for conducting the business of the Association, and the instructions have been carried out. The local committee arranged for entertainment for our Twelfth Annual Convention, and the president presented a programme in accordance with such an arrangement.

Three times have we been reminded of the shortness of time, by the death of three of our members: Mr. J. W. Taylor, of the Ter. Ry. Asso., of St. Louis, Mo.; Mr. S. S. Millener, of the B. & O. S. W. R. R., Washington, Ind., and Mr. J. A. Spangler, of the B. & O. Ry., Washington, Pa. We have now on our rolls 157 names, and 29 applications, to be acted upon to-day, and the Association is in a prosperous condition.

I wish to thank our advertising patrons for their liberal support and friendly greetings; also to thank our members for their kind assistance and forbearance.

FINANCIAL.

Dr.

Cash on hand at last report, in my hands	$232.60	
Cash received for dues and new members	553.50	
Cash received for advertisements	1,086.00	
Cash received for sale of books and tables	54.50	
		$1,926.60

Cr.

By cash paid out for which I hold vouchers	$1,613.17
Balance in my hands	$313.43

Respectfully submitted,

S. F. PATTERSON,
Secretary.

President.—What shall be done with the secretary's report?

Mr. Markley.—I move that it be received, referred to the Auditing Committee, and printed in the Proceedings.

Motion seconded and carried.

President.—We will next listen to the treasurer's annual report, which will be read by the assistant secretary.

Treasurer's report read by the assistant secretary, Mr. B. F. Pickering.

To the President and Members of the Association of Railway Superintendents of Bridges and Buildings:

MINNEAPOLIS, MINN., October 21, 1902.

Your treasurer submits the following report:

Cash on hand October 15, 1901	$719.51

All of which remains on hand.

N. W. THOMPSON,
Treasurer.

Mr. Cummin.—I move that it be received, referred to the Auditing Committee, and printed in the Proceedings.

Motion seconded and carried.

President.—The next order of business is the appointment of committees, and I will now proceed to appoint them as follows:

NOMINATING COMMITTEE.

J. H. Cummin, A. S. Markley, James Stannard.

AUDITING COMMITTEE.

R. H. Reid, J. B. Canty, J. H. Markley.

COMMITTEE ON RESOLUTIONS.

W. A. McGonagle, J. S. Lemmond, W. E. Smith, W. M. Noon, H. D. Cleaveland.

President.—We will next listen to the annual report of the Executive Committee, which will now be read by the secretary, Mr. S. F. Patterson.

Annual report of the Executive Committee was then read by the secretary.

ANNUAL REPORT OF THE EXECUTIVE COMMITTEE.

ABSTRACT OF MINUTES OF EXECUTIVE COMMITTEE, HELD AT THE KIMBALL HOUSE, ATLANTA, GA., OCTOBER 17, 1901.

Meeting called to order at seven o'clock p. m., October 17, 1901, by Mr. C. P. Austin.

Members present: C. P. Austin, Walter G. Berg, Jos. H. Cummin, B. F. Pickering, N. W. Thompson, W. O. Eggleston, C. A. Lichty, W. A. Rogers, S. F. Patterson.

On motion of Mr. Cummin, voted to appoint Mr. Walter G. Berg to act in conjunction with the secretary to edit the Proceedings of the Convention.

Secretary instructed to have one thousand copies of the Proceedings of the Eleventh Annual Convention printed.

On motion, voted to make selling price of the Proceedings seventy-five cents per copy.

On motion of Mr. Berg, the secretary was instructed to endeavor to get as many illustrations as desirable in the printed Proceedings, and is hereby authorized to pay for the necessary tracings for such illustrations, which in his opinion it is desirable to embody in the Proceedings.

Moved by Mr. Cummin, that Mr. W. A. McGonagle and Mr. C. A. Lichty be appointed a local Committee on Arrangements for the next meeting at Minneapolis, with power to act. Motion carried.

Moved by Mr. Berg, that the president be requested to prepare, and present at the spring meeting of the Executive Committee, a draft of a programme for the next annual convention. Motion carried.

Mr. Cummin moved that the annual dues be fixed at $2.00, beginning the third Tuesday in October, 1902. Motion prevailed.

Voted, that the next meeting of the Executive Committee be held at the Leland Hotel, Chicago, February 22, 1902, at ten o'clock a. m., unless convened sooner by the chairman of the Executive Committee.

On motion, adjourned at eight o'clock p. m.

ABSTRACT OF MINUTES OF MEETING OF EXECUTIVE COMMITTEE HELD AT LELAND HOTEL, CHICAGO, ILL., FEBRUARY 22, 1902.

Meeting called to order at ten o'clock a. m., by the chairman, Mr. Arthur Montzheimer.

Members present: A. W. Merrick, W. S. Danes, C. A. Lichty, W. O. Eggleston, S. F. Patterson, N. W. Thompson, James Stannard, Walter A. Rogers, Aaron S. Markley. Mr. Riney came in later.

Letters of regret read from Mr. W. A. McGonagle, J. H. Cummin, W. G. Berg, and C. P. Austin. Minutes of last meeting read and approved.

Letter read from Mr. I. O. Walker, president of the Roadmasters' and Maintenance of Way Association, in regard to the two associations meeting at the same place and week, suggesting that one meet the three first days of the week, and the other the three last days of the same week. After discussion, the secretary was instructed to write Mr. Walker that his communication had been received and considered by the Executive Committee, and the matter referred to our next convention.

Mr. McGonagle, chairman of the Local Committee, recommended meeting at the West Hotel, Minneapolis, for our next convention; also recommended a side trip to Duluth. Report was accepted, and the recommendation adopted, leaving the matter of side trip in the hands of the local committee, to complete the arrangements.

Mr. J. H. Cummin appointed a committee to procure badges for guests.

Mr. Stannard reported the death by accident of Mr. J. W. Taylor, chief engineer of the St. Louis Terminal Railroad Co., and the secretary was instructed to write to his family, in behalf of the Association, a letter of sympathy.

Mr. W. G. Berg appointed a Committee on Memoirs.

Local committee requested to invite Mr. Hill, or Mr. Morgan, to address our next convention. President requested to secure a paper from some member, or some outside party, to be read at the next convention.

By vote, the dues of Edward F. Reynolds were remitted to October, 1902.

No further business appearing, adjourned to meet at the West Hotel, Minneapolis, October 20, 1902, at 8 o'clock p. m.

ABSTRACT OF MINUTES OF MEETING OF EXECUTIVE COMMITTEE, HELD AT THE WEST HOTEL, MINNEAPOLIS, MINN., MONDAY EVENING, OCTOBER 20, 1902.

Meeting called to order by Chairman Montzheimer at eight o'clock p. m.

Members present: Arthur Montzheimer, chairman, Cyrus P. Austin, C. A. Litchty, W. E. Smith, J. H. Cummin, James Stannard, W. S. Danes, Secretary Patterson, A. S. Markley, H. D. Cleaveland, B. F. Pickering, W. M. Noon.

Secretary read a statement giving some interesting data, showing the Association to be in a good financial condition.

Secretary stated that Mr. Wm. Carmichael, of the Chicago, Rock Island & Pacific road, had sustained a serious injury, resulting in the loss of one of his legs and was having a very hard time of it, and recommended that his dues be remitted, and upon regular motion of Mr. Stannard decided that this be done.

Mr. McGonagle, chairman of the Local Committee, advised that Mr. Jas. J. Hill promised to address the Convention, but had just received information that his presence would be required elsewhere, and it would be impossible for him to be with us, but that addresses of welcome would be delivered by the acting mayor and Mr. G. W. Nye, chairman of the Commercial club.

Mr. McGonagle also stated that the general manager of the Great Northern road said it would afford him great pleasure to haul two or three Pullman sleepers and take our entire party to Duluth and return. Also advised that the Commercial club had arranged for a theater party for Wednesday night, and to otherwise entertain the members in many pleasant ways.

The abstract of minutes of the three meetings of the Execu-

tive Committee, held during the year, was ordered submitted to the Convention as the annual report of the Executive Committee.

Adjourned at 9 : 10 p. m.

S. F. PATTERSON,
Secretary.

President.—Gentlemen, what shall be done with the report of the Executive Committee?

Mr. Stannard.—I move that the report be received and published in our Proceedings.

Mr. Markley.—I second that motion.

President.—It has been moved and seconded that the report be received and published in our Proceedings; all in favor of this motion please say Aye.

President.—The motion is carried and this action will be taken.

President.—Next we will hear the report of the Committee on Memoirs.

Report of Committee on Memoirs read by Assistant Secretary B. F. Pickering.

REPORT OF COMMITTEE ON MEMOIRS.

Your Committee on Memoirs presents herewith memoirs of our deceased members, as follows : J. A. Spangler, who died in October, 1901, J. W. Taylor, who died December 26, 1901, and S. S. Millener, who died January 20, 1902.

WALTER G. BERG,
Committee.

MEMOIR.

J. A. SPANGLER.

ELECTED MEMBER	October 17, 1893.
DIED	October, 1901.

J. A. Spangler was supervisor of bridges and buildings on the Pittsburg Division of the Baltimore & Ohio Railway, with headquarters at Washington, Pa.

He was seriously injured in a wreck on the road east of Washington, Pa., and died one week after the accident without regaining consciousness.

Mr. Spangler joined the Association at the third convention in Philadelphia, Oct. 17, 1893. He was known to take great interest in the

work of the Association, and had many warm friends among the members.

He was the patentee of a track pile-driver, known as "Spangler's Track Pile-driver," and had expected to resign his position on the railroad in the month following his death, so as to devote his time to the development of his patent.

MEMOIR.

JOHN W. TAYLOR.

ELECTED MEMBER	October 15, 1901.
DIED	December 26, 1901.

John W. Taylor was chief engineer of the Terminal Railroad Association of St. Louis, and of the St. Louis Merchants' Bridge Terminal Railroad.

At the time of his death, on Dec. 26, 1901, he was making an inspection trip of the Terminal Railroad on a gasoline motor car, and in approaching the crossing of the Wabash R. R. at North St. Louis, fearing a collision with a Wabash switching engine, jumped from the car, was thrown in front of the engine and instantly killed.

Mr. Taylor was born Dec. 9, 1866, in Decatur, Ill., and graduated from the University of Illinois. He entered railroad service in 1886, serving successively as chainman and draftsman for the St. Louis & Chicago R. R., assistant engineer of the St. Louis, Alton & Terre Haute R. R., and architect in private practice in Knoxville, Tenn. In 1892 he was appointed assistant engineer of the St. Louis Terminal Railroad Association, and was promoted to the position of chief engineer on June 1, 1900.

Mr. Taylor joined the Association of Railway Superintendents of Bridges and Buildings at the Atlanta convention on October 15, 1901, and was appointed a member of the Committee on "Best Materials and Designs for Roundhouse Pits," but his death occurred within less than three months after his becoming a member, thereby depriving the Association of an esteemed new member, and one from whom the Association could have expected valuable assistance.

MEMOIR.

S. S. MILLENER.

ELECTED MEMBER	October 16, 1894.
DIED	January 20, 1902.

S. S. Millener was supervisor of bridges and buildings on the Baltimore & Ohio Southwestern Railroad at Washington, Ind.

His health had been poor for some years prior to his death, and at the time of the last convention of the Association at Atlanta, in October, 1901, he was in Southern California seeking to regain his lost health.

He joined the Association at the fourth convention at Kansas City, Oct. 16, 1894, and subsequently was present at the New Orleans convention in 1895, and at the St. Louis convention in 1900.

He served on the committee appointed in 1900 to report on "The best and most convenient outfit for bridge gangs and number of men constituting a bridge gang."

Mr. Markley.—I move that the report of the Memoir Committee be received and made a part of our Proceedings.

Motion seconded and carried.

President.—Next in order will be report of Committee on Selection of Subjects.

Mr. Mallard.—Mr. President, Mr. Berg, the chairman, sent me such papers as he had collected, and I would ask for further time on this, and suggestions from any of the members so we can bring in a full report. If any of the members here would like to have any subjects brought up at the next meeting, will be glad to have them handed to me, and I will make a report later, at the pleasure of the Convention.

Secretary.—I have another report just handed to me which I will read.

Report of Committee on Relief read by Assistant Secretary Pickering.

WEST HOTEL,
MINNEAPOLIS, MINN., Oct. 21, 1902.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your Committee appointed on Relief at our last meeting, which was held at Atlanta, Ga., are happy to inform you that during the past year there have been very few applications for relief, but quite a number of roads have asked that we recommend to them good men for different positions, which your committee has taken great pleasure in so doing, which indicates that prosperous times are still with us, and may they always continue.

Respectfully submitted,

JAMES STANNARD,
GEO. J. BISHOP,
C. W. VANDERGRIFT,
J. Y. HILL,
Committee.

President.—You have heard the report, what shall be done with it?

Mr. McGonagle.—I move the report be received and spread on the minutes.

Mr. Markley.—I second that motion.

President.—All in favor of that motion please say Aye. The motion prevails.

President.—The next order of business will be reading of

the reports of the Committees on Investigation. We will now listen to the report on subject number one, "Auxiliary Coaling Stations; Best Designs, Capacity, and Method of Handling Coal." Mr. McGonagle, chairman.

Report on subject number one read by Mr. McGonagle. (See report on subject number one.)

President.—We will now adjourn for dinner, and I would like to have all the members here at two o'clock p. m., so we can commence promptly on time.

AFTERNOON SESSION, TUESDAY, OCTOBER 21, 1902.

President.—The Convention will please come to order.

President.—I think subject number two, "Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expenses for Various Classes of Railroad Buildings," is next, but as I understand no report has been made by the committee on this subject, we will have to pass it. We have a written discussion on this subject, however, from Mr. Snow, and if you would like to hear it we will have the assistant secretary read it.

Mr. Cummin.—Mr. President, inasmuch as the discussion of subjects has not come up yet, I move that this be deferred until the regular discussion.

President.—All in favor of that motion please say Aye. The motion prevails.

President.—The next will be subject number three, "Mail Cranes, First Cost, Efficiency, and Maintenance of Various Styles in Use." Mr. A. S. Markley is chairman of that committee.

Report on subject number three read by Mr. Markley. (See report.)

President.—The next will be subject number four, "Best Method of Protecting Low Overhead Structures over Tracks from Gases and Blast of Locomotives," Mr. G. W. Andrews, chairman. Have you got any report on this subject, Mr. Secretary.

Secretary.—No, sir.

President.—Is there any member of that committee present who has any report on this subject?

Mr. Lemmond.—I wrote Mr. Andrews about it but I have no report to make on it.

President.—The next is subject number five, "What has been the Experience in the Use of Concrete under Bridge Bed-plates and Turn-tables in place of Pedestal Stones, and what is the Best Form and Material for Bed-plates under Various Styles of Iron Bridges?" Mr. W. A. Rogers, chairman. The committee on this subject is as follows: W. A. Rogers, Frank W. Tanner, George J. Bishop, J. H. Markley, A. McNab, and George E. Hanks. Is there any member of that committee present who has anything to say on the subject? Have you anything to offer on this subject, Mr. Markley?

Mr. J. H. Markley.—No, sir, I have not heard from the chairman at all.

President.—The next will be subject number six, "Best Design and Recent Practice in Building Railroad Track Pile-driver." Mr. B. F. Pickering, chairman.

Mr. Pickering read report of the committee on subject number six. (See report.)

Mr. Pickering.—I would say in addition in regard to the extracts attached to this report, that it is hardly necessary for me to read them, as we all have the printed reports before us, but I would like to ask the permission, as chairman of the committee, of the Association to enlarge somewhat upon this report, and correct some few points in it before it goes into the Proceedings, as we have been able to gather some reports since this went to press that will quite materially add to the subject.

President.—Next is subject number seven, "Best Material and Designs for Roundhouse Pits, Including Drainage and Rail Fastenings." Mr. Arthur Montzheimer is here and is chairman of this committee.

Report on subject number seven read by the chairman, Mr. Montzheimer. (See report.)

President.—Subject number eight is next, "Best Materials for Wearing Surface of Roadway of Highway Bridge Floors."

Mr. W. O. Eggleston, chairman. Have you any report, Mr. Secretary.

Secretary.—Yes, sir.

Report on subject number eight read by Mr. Pickering. (See report.)

President.—Gentlemen, we now understand that the next order of business is the discussion of last year's subjects. If no other business is before the house we will proceed with that.

Mr. Markley.—Mr. President, last year three subjects, questions relating to turning engines on turn-tables, were given out to individual members to report on at this time, one was to myself, one to Mr. Schall, and one to Mr. Eggleston. I am prepared to get rid of that report and would be glad to make it while under this head, and if you decide that you would like to have that report now, I will be glad to make mine.

President.—Well, we will hear those reports now, Mr. Markley.

Mr. Markley.—Before reading my report I would like to double up the dollars and cents. Instead of being seventy-eight and one half cents for turning the engines in twenty-four hours, it should be one dollar and fifty-seven cents. I do that in justice to Mr. Schall. There was a little error in my report. I do not want to do anything that is not right, and am glad that Mr. Schall called my attention to the matter.

Individual or auxiliary report on turning engines by hand power then read by Mr. A. S. Markley. (See report.)

President.—We will now hear from Mr. Schall.

Mr. Schall.—I was chairman last year of the committee to report on the subject of operation of turn-tables by power, and was afterwards delegated to get some additional information as to the cost, and to make a supplementary report this year, which I have done, and will be pleased to read it.

Report on cost of operating turn-tables by gasoline and electric power read by Mr. Schall. (See report.)

Mr. Pickering.—Mr. President, I will read the auxiliary report by Mr. Eggleston on the operation of turn-tables by steam power. (See report.)

President.—I think we will now call for discussion of last

year's subject number four, "Best Method of Operating Turn-tables by Power." (See discussion.)

President.—We will now pass on to last year's subject number one, "Methods of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under." Mr. G. W. Andrews was chairman of that committee. I would like to hear from some member on this subject. (See discussion.)

President.—Does any other member wish to say anything on this subject? If not we will take up last year's subject number two, "Passenger Platforms at Way Stations, Best Material and Cost of Same." Mr. J. B. Sheldon was chairman of the committee on that subject. (See discussion.)

President —We will now pass to the next subject, number three, "Slips for Ferry Boats Used for Transferring Railway Cars." Mr. Isaacs was chairman of that committee.

President.—I find there was no report on this subject, therefore we will pass to subject number five, "Auxiliary Coaling Stations; Best Design, Capacity, and Method of Handling Coal." Mr. W. A. McGonagle, chairman.

Mr. Cummin.—Think we should pass this subject over for the present, as that is one of this year's subjects; there was no report made on it last year and it will come up this year.

President.—I think that is the proper thing to do, so we will pass to number six, "Water Stations; Best. Material for Foundations, Tanks, Substructure, Connections, Capacity," etc. Mr. Markley was chairman of the committee on that subject. (See discussion.)

President.—We will pass to subject number seven, "Is it Best for Railroad Companies to Erect Their Own Steel Structures, or Let the Manufacturers Erect Them?" Mr. O. J. Travis was chairman of that committee. (See discussion.)

President.—We will now pass to subject number eight, "The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang." Mr. A. W. Merrick was chairman of the committee on this subject. Would like to hear from any of the members on this subject. (See discussion.)

President.—Before we adjourn I believe Mr. Reid wishes to make some remarks about his committee.

Mr. Reid.—I would like to see the members of the Auditing Committee after the close of this meeting, and think that if we can get together right after this meeting is over we can close up the affairs in a very short time.

Mr. Cummin.—I move, Mr. President, that we adjourn to meet again at 7 : 30 o'clock this evening in some other room.

Motion seconded by Mr. Stannard.

President.—All in favor of the motion please say Aye, those opposed, Nay. The Ayes have it and the meeting will be adjourned until 7 : 30 to-night, to meet in another room which the hotel people will provide for us.

EVENING SESSION, TUESDAY, OCTOBER 21, 1902.

Meeting called to order by the president, Mr. Danes, 7 : 30 o'clock p. m., in south parlor of the West Hotel.

President.—The first subject for discussion will be this year's subject number one, "Auxiliary Coaling Stations; Best Designs, Capacity, and Method of Handling Coal." This subject was brought forward from last year, and Mr. W. A. McGonagle is chairman of the committee on same. (See discussion.)

Mr. Cummin.—As the hour is getting late I would suggest that, in place of taking up another subject to-night, we call for reports of the different committees, the Nominating Committee, the Committee on Subjects, and one or two other little matters that we might take up now.

President.—If the Committee on Subjects are ready to make their report we will now listen to it.

Report of Committee on Subjects read by Mr. Mallard.

REPORT OF COMMITTEE ON SUBJECTS.

1. Best false work for rocky bottom in rapid currents where piles cannot be driven.
2. Should ties of bridges be gained so as to leave rail without camber or should a portion of camber be taken out?
3. In case one arm of an important metal drawbridge, over a deep stream, should be wrecked, what is the most expeditious way to restore railway and water traffic?

4. What is the best form of traveler to use in erecting steel railway bridges of spans up to 200 feet?
5. Best method of protecting solid steel floors of bridges.
6. Best plans for small tool houses, including switchmen and car repairers' shanties and section-tool and hand-car houses.
7. Best practicable sanitary arrangements for small stations where there are no water or sewer systems.
8. Best method of making annual inspection of bridges and culverts and form of report to be made.
9. Water filters or other methods of purifying water for engine use.
10. Best methods of storing fuel oil, with appliances for supplying locomotives, including plan of water stations, showing relative arrangement of fuel and water supply.

W. G. BERG,
C. C. MALLARD,
W. A. MCGONAGLE,
J. H. CUMMIN,
Committee.

President.—What shall be done with the report?

Mr. Markley.—I move the report be adopted.

Mr. Lichty.—I second the motion.

President.—All in favor of that motion please signify it by saying Aye. The motion prevails.

Mr. Cummin.—Mr. President, the Nominating Committee would respectfully present the following report:

President.—B. F. Pickering, B. & M. R. R.
First Vice-President.—C. C. Mallard, So. Pac. Co.
Second Vice-President.—A. Shane, T., St. L. & K. C. R. R.
Third Vice-President.—A. Zimmerman, Col. & So. Ry.
Fourth Vice-President.—Arthur Montzheimer, C. & N. W. Ry.
Secretary.—S. F. Patterson, B. & M. R. R.
Treasurer.—N. W. Thompson, P., F. W. & C. Ry.
Executive Committee.—W. E. Smith, C., M. & St. P. Ry.; A. W. Merrick, C. & N. W. Ry.; C. P. Austin, B. & M. R. R.; C. A. Lichty, C. & N. W. Ry.; W. O. Eggleston, C. & Erie R. R.; J. H. Markley, T., P. & W. Ry.

J. H. CUMMIN,
J. STANNARD,
A. S. MARKLEY.
Committee.

President.—What shall we do with the report of the Nominating Committee? Unless there are objections the report will be spread upon the minutes as read.

Mr. Stannard.—I move that we now adjourn until nine o'clock to-morrow morning.

Motion seconded and carried.

President.—We will now adjourn until to-morrow morning at nine o'clock.

MORNING SESSION, WEDNESDAY, OCTOBER 22, 1902.

Meeting called to order by President Danes at 9.35 o'clock a. m.

President.—There was an appointment of one committee which was overlooked yesterday, the Obituary Committee, and I will appoint Messrs. Joseph H. Cummin, R. H. Reid, and R. C. Sattley as that committee.

President.—Is there any other committee ready to report? If not we will take up subject number two for discussion, "Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expenses for Various Classes of Railroad Buildings." (See discussion.)

President.—We will now pass to subject number three, "Mail Cranes, First Cost, Efficiency, and Maintenance of Various Styles in Use." Mr. A. S. Markley is chairman of this committee. (See discussion.)

President.—Next will be subject number four, "Best Method of Protecting Low Overhead Structures over Tracks from Gases and Blast of Locomotives," but there is no report on this subject. Also no report on subject number five, "What has been the Experience in the Use of Concrete under Bridge Bed-plates and Turn-tables in place of Pedestal Stones, and what is the Best Form and Material for Bed-plates under Various Styles of Iron Bridges?" Therefore, as no committee reports have been made on subjects numbers four and five, we will pass on to subject number six, "Best Design and Recent Practice in Building Railroad Pile-driver." Mr. B. F. Pickering is chairman of that committee. (See discussion.)

President.—We will now pass to subject number seven, "Best Material and Designs for Roundhouse Pits, including Drainage and Rail Fastenings." Mr. Arthur Montzheimer, chairman. (See discussion.)

President.—The next subject is number eight, "Best Materials for Wearing Surface of Roadway of Highway Bridge

Floors." There is a report and we will now take this subject up before we adjourn. (See discussion.)

President.—Before adjourning Mr. McGonagle wishes to make a statement.

Mr. McGonagle.—A trip has been arranged for this afternoon by the Minneapolis Commercial club, carriages will be in waiting at the entrance to the hotel at two o'clock. We will all go with our ladies and take a trip to the various points of interest about the city and to the Pillsbury Flouring Mills, Meeker Island Dam, etc.; also a theater party has been arranged by the Minneapolis Commercial club for to-night, and each member is requested to come forward immediately after the close of the session at noon to-day and secure these tickets. After the members are supplied, if there are any tickets left over they are to be distributed to the friends of the Association. The members, however, are to be supplied first. This is the desire of the Commercial club. In regard to the trip tomorrow afternoon, it has been arranged to leave the hotel at one o'clock p. m., and to proceed by special trolley cars to St. Paul, and to visit the Indian mounds, state fish hatchery, the American Hoist and Derrick company's works, etc., and afterwards to attend a dinner to be given at the Commercial club rooms, St. Paul, as the guests of the American Hoist and Derrick company.

Mr. McGonagle.—Mr. President, I have the report of the Committee on Resolutions ready to read.

President.—All right, we will be glad to listen to it, Mr. McGonagle.

Report of Committee on Resolutions thereupon read by Mr. McGonagle, chairman:

Your Committee on Resolutions beg leave to report as follows:

Resolved, That the thanks of this Association are hereby tendered to the Great Northern Railway, the Duluth, Missabe & Northern Railway, and the Duluth & Iron Range R. R. for courtesies extended to the members of our Association in the way of free transportation.

Resolved, That the thanks of our Association are hereby tendered to the Pullman company for special rates of transportation for our members. Also to the manager of the West Hotel for courtesies extended in arrangements for our comfort.

Resolved, That we duly appreciate the courtesies extended to us

by Mayor Jones of Minneapolis, and by Mr. W. G. Nye, representing the Minneapolis Commercial club, for many courtesies extended to our ladies as well as to our members, and for the hospitable welcome to Minneapolis.

Resolved, That the thanks of our members are hereby tendered to the American Hoist and Derrick company for very pleasant entertainment for our ladies and our members during the trip to St. Paul.

Resolved, That we hereby tender our thanks to each and all of our members who have in any way contributed to the success of our Convention.

W. A. McGonagle,
W. M. Noon,
H. D. Cleaveland,
J. S. Lemmond,
W. E. Smith,
Committee.

Mr. Cummin.—I would move that we add to that report, that the most sincere thanks of this Association be extended to Mr. McGonagle and the Local Entertainment Committee for the elegant entertainment provided for our Association while at Minneapolis, and for the trip that has been arranged to the iron ranges.

Mr. Markley.—Second the motion.

Mr. McGonagle.— I wish this addition would not appear in the resolutions. If the Local Committee have done anything to receive the thanks of the Convention we know that we have those thanks, and it is not necessary to place this on record, as we have simply done our duty and do not desire any record to be made.

Mr. Cummin.—We will let this come in afterwards as an additional resolution.

President.—You have heard the report of the Committee on Resolutions.

Mr. Stannard.—I move the adoption of the report.

Motion seconded and carried.

President.—We will listen to the report of the Auditing Committee.

Report of Auditing Committee read by Mr. Reid.

To the Association of Railway Superintendents of Bridges and Buildings:

We, the undersigned Auditing Committee, beg leave to present the following:

REPORT OF SECRETARY.

On hand and dues collected	$786.10	
Sale of Proceedings	54.50	
Advertisements	1,086.00	
Total received		$1,926.60
Expenses		1,613.17
Cash in hands of secretary, October 21, 1902,		$313.43

REPORT OF TREASURER.

Cash on hand, October 21, 1902	$719.51

R. H. REID,
J. H. MARKLEY,
J. P. CANTY,
Auditing Committee.

President.—You have heard the report, what shall we do with it?

Mr. Stannard.—I move the report be received and placed in our records.

Mr. Pickering.—I second the motion.

President.—All in favor please say Aye, those opposed, Nay. The motion is carried.

President.—We will now adjourn the meeting until to-morrow at ten o'clock a. m.

MORNING SESSION, THURSDAY, OCTOBER 23, 1902.

Meeting called to order by the president at 10 o'clock a. m.

President.—The first thing to come up this morning will be listening to letters of regret from those members unable to attend the Convention.

Mr. Pickering then read letters of regret from W. A. Rogers, A. Shane, M. D. Short, C. W. Gooch, H. M. Henson, G. O. Lilly, W. G. Berg, A. Zimmerman, C. W. Vandergrift, P. N. Watson, and O. J. Travis.

President.—Is the Committee on Obituary ready to make their report?

Report of Obituary Committee read by Mr. Cummin.

WHEREAS: God in His infinite wisdom has been pleased to remove from our number three of our members, thus severing more links in the chain of friendship that binds us together, and again reminding us of the uncertainty of human life, and the immutable certainty of death, therefore be it

Resolved: That we, as an Association, sincerely mourn the loss of these members, Messrs. J. W. Taylor, J. A. Spangler, and S. S. Millener.

Resolved: That the sympathy of this Association be tendered to the families of our deceased members by the Secretary, and that a copy of these resolutions be printed in full in our Proceedings.

J. H. CUMMIN,
R. C. SATTLEY,
R. H. REID,
Committee.

President.—You have heard the report of the Obituary Committee. What do you wish to do with the report?

Mr. Markley.—I move the report be adopted and placed on record in our Proceedings.

Motion seconded and carried.

President.—Next thing will be unfinished business. Has any member anything to offer under that head?

Secretary Patterson.—Mr. President, under the head of unfinished business there is a matter that came up before the Executive Committee of this Association the other night in the way of a communication from the Roadmasters' Association from Mr. Walker, in regard to our meeting the same week that they meet and at the same place. It is suggested that we meet the three first days of the week, or, that is, that one Association meet the three first days of the week and the other the three days following, so we can mingle together, or enjoy each other's outing, by holding the conventions together at the same place and the same time.

The Executive Committee have referred the matter to the Convention.

Mr. Pickering thereupon read the following letters from Mr. I. O. Walker, President Roadmasters' and Maintenance of Way Association.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION.
OFFICE OF PRESIDENT.
PADUCAH, Ky., Dec. 17, 1901.

S. F. Patterson, Sec'y Ass'n of R. S. of B. & B., Concord, N. H.

DEAR SIR:—I am directed by the Executive Committee to ask you to ascertain if your Executive Committee can arrange to have your meeting take place on the third Tuesday in September instead of the third Tuesday in October. Many members of the Road-

masters' Association are interested in bridge work, and probably a good many of them are members of your Association. The idea is that quite a number of the members will be able to stay over and meet with you next fall if your meeting takes place one week after ours.

I believe it would be one of the best things that could happen for both associations if we could arrange to meet in the same place, and in the same week, hereafter; one association to take the first three days, the other association the last three days of the week, and I believe it will be advisable to bring this matter before both associations next fall and see if this cannot be arranged. The Executive Committee would have been glad to have changed the meeting date of our Association to agree with yours but that power is not vested in the Executive Committee under our present by-laws.

Yours,

I. O. WALKER.

PADUCAH, Ky., Dec. 21, 1901.

S. F. Patterson, Sec'y Ass'n of Sup'ts B. & B., Concord, N. H.

DEAR SIR: Answering your favor of Dec. 17th, I wish to say it was not the intention of our association to ask your association to join with us, but simply to have the meetings as near together in distance and time as convenient. I had forgotten in my former letter to tell you that our meeting takes place on the second Tuesday in September, while yours takes place on the third Tuesday in October. I believe it would be well to take up this matter at the next meeting of your association, unless it can be handled entirely by the Executive Committee. I believe if we would meet in the same town hereafter,—say, your meeting take place on the first three days of the week, and our meeting take place the second three days of the same week,—that both associations would be benefited.

Yours,

I. O. WALKER.

Mr. Cummin.—Mr. President, as that letter states, this subject came up about eleven years ago in this Association; at that time it was decided by the members of our Association that they did not think it was wise to merge, if I might use that term, the two associations into one. As for our meeting at the same time and place, I think most assuredly that the same arguments that held good at our meeting in Cincinnati hold good to-day, if not stronger. At that time we were a weak organization, but at the same time we thought that we were able to paddle our own canoe and to stand on our own bottom, and I think that if we were then, that we are still more able at the present time. While we, as superintendents of bridges and buildings, are brought closely in contact with the roadmasters and supervisors of the different railroads,—in fact, more closely connected with them than any other branch

of a railroad system,—yet it seems to me that it would be wiser for us to continue in the way we have been going on for the past few years than to accede to this request. There would be differences come up; probably the most important one, in regard to the place of meeting. The roadmasters heretofore have been meeting in the month of September; they have now already changed their date to the same date that we meet. At their last convention in Milwaukee the date of meeting was left with the executive committee. They held a meeting in Chicago a week ago Monday, and decided on the third Tuesday in October, 1903, at Kansas City, Mo. That is our regular fixed date of meeting, and if they are going to meet the third Tuesday, I fail to see where each association can get three days in the same week, unless we carry our meeting over and meet on Sunday, and it seems to me that their action in changing their date would preclude any possibility of our taking the action requested of us at this time. I would, therefore, move, Mr. President, that the secretary be instructed to say, that after due consideration, the Association of Railway Superintendents of Bridges and Buildings have decided to continue along the same lines as at present.

Mr. Mallard.—I second the motion.

President.—Gentlemen, you have heard the motion, all in favor of same will please signify it by saying Aye; those opposed, Nay. The motion is carried.

Secretary Patterson.—There is another matter that I suppose might come up under this head in regard to the changing of the constitution and by-laws. It was discussed somewhat in the Executive Committee, namely, in regard to the change in the annual dues.

Mr. Cummin.—Mr. President, at the last Executive Committee meeting held in Atlanta, Ga., there was a resolution brought up by myself to the effect that, commencing October, 1902, the annual dues of this Association be two dollars a year. Of course that could not be fully acted upon at that time. I move now, sir, that the constitution and by-laws be corrected to make the dues two dollars instead of three dollars.

Mr. Stannard.—I second the motion, Mr. President.

President.—It has been moved and seconded that the constitution and by-laws be changed to make the dues read two dollars instead of three dollars a year, all in favor of this motion please say Aye; those opposed, Nay. The Ayes have it, and the motion prevails.

President.—We will close on unfinished business and pass to new business.

Mr. Cummin.—Under the head of new business, Mr. President, there is a matter that I would like to bring before the members of this Association. We have two members of this Association, Mr. N. W. Thompson and Mr. Holland W. Fletcher, who have always taken an active interest in the meetings and in the proceedings of this Association, and, as a rule, have attended, I believe, about every meeting that we have had. They are now retired from active service in railroad work, and I would therefore move, sir, that these two members be elected life members of the Association of Railway Superintendents of Bridges and Buildings, entitled to all its rights and privileges, and exempt from all dues to the Association of any kind.

Mr. Mallard.—I second the motion.

Mr. Markley.—Before any action is taken, would it not be necessary to embody or incorporate this resolution as to creating life members in our by-laws and constitution before we go ahead? I assure you that I am strictly in sympathy with the movement, but would do it legally and in a proper way.

Mr. Cummin.—There is nothing in the constitution or by-laws of this Association that prohibits any such action being taken by the Convention at any time.

Mr. Markley.—I don't think this can be done without first going through the Executive Committee.

Mr. Cummin.—I claim that this body when in convention is superior to the Executive Committee of this Association, and I claim this as a member of the Executive Committee myself.

Mr. Pickering.—I heartily agree with Mr. Cummin, but it seems to me that it is necessary for this matter to come up in the form of an amendment to article nine of the constitution,

because that provides that no member being one year in arrears for dues will be entitled to vote at any election, and any member one year in arrears may be stricken from the list of members at the discretion of the Executive Committee. Now, how would it be if a member had no dues to pay?

Mr. Cummin.—These two members are in good standing as members of this Association; they have paid up their dues to date, and stand equal with any member on the floor of this Convention, but in honor to their past service, which has covered many years, is the reason I offered the resolution that I did.

President.—Gentlemen, you have heard the resolution offered by Mr. Cummin, that the two members referred to by him be elected life members of this Association, to be exempt from all dues, and to be entitled to all the rights and privileges of the Association. All in favor of that resolution please signify it by saying Aye; those opposed, Nay. The Ayes have it.

Mr. Markley.—Now, in line with this resolution, Mr. President, I move that the by-laws and constitution be made to read in accordance with this resolution, so that any one reading our by-laws and constitution will understand the matter.

Mr. Stannard.—Do n't think there is any necessity of doing that; the constitution does not have to read that way.

Mr. Cummin.—Mr. President, in order to prevent any future agitation on this subject I think it might be wise to just add another clause in regard to life membership; that would settle the whole matter.

Mr. Markley.—I would move then, Mr. President, that another clause be added to our constitution to embody the motion or resolution offered by Mr. Cummin.

Mr. Reid.—I second the motion.

President.—All in favor of the motion please say Aye. The Ayes have it and the motion is carried.

Mr. Cummin.—I think it would be well, when the secretary makes out the directory of members in our proceedings, in addition to showing the list of active and deceased members, to add the life members under a separate heading, to show who the life members of this Association are; that

is, in the directory of members where printed in our Proceedings, that these two gentlemen appear as life members separate from the others.

Secretary Patterson.—Are there any other members that would naturally come under this head? How about our esteemed member, John Foreman?

Mr. Cummin.—He has not retired and never will. He has only been superintendent of bridges and buildings of the Philadelphia & Reading railroad for fifty-eight years, and he is not ready to retire yet.

President.—Mr. Cummin, will you please read the list of nominations?

List of names recommended for the various offices by the Nominating Committee thereupon read by Mr. Cummin, the chairman of that committee.

President.—B. F. Pickering.
First Vice-President.—C. C. Mallard.
Second Vice-President.—A. Shane.
Third Vice-President—A. Zimmerman.
Fourth Vice-President.—A. Montzheimer.
Secretary.—S. F. Patterson.
Treasurer.—N. W. Thompson.
Executive Members.—W. E. Smith, A. W. Merrick, C. P. Austin, C. A. Lichty, W. O. Eggleston, J. H. Markley.

President.—Gentlemen, you have heard the report of the Nominating Committee, what shall be done with it?

Mr. Cummin.—I would move that Mr. Reid cast one ballot for the names upon this list.

Mr. Lichty.—I second the motion.

Motion carried.

Mr. Reid.—Mr. President, the vote of the Association is hereby cast for the members for the respective offices as recommended.

President.—The ballot has been cast and the names read by Mr. Reid are thereby duly elected for the coming year.

President.—Mr. Pickering, you have been elected president of this Association, do you accept the office?

Mr. Pickering.—I do, sir, with thanks.

Mr. Danes.—I turn the gavel over to you, and I wish to thank all the members of this Association for the honor bestowed upon me and for the interest they have shown in this

Convention. Thanking you all, I turn the office over to Mr. Pickering.

President Pickering.—Gentlemen, I believe as to the names of the other gentlemen who have, like myself, been honored at your hands, that it is customary to ask all if they accept the the office to which elected. Mr. C. C. Mallard, do you accept the office of first vice-president?

Mr. Mallard.—I thank you for the honor. I hardly expected to reach or climb so high in the ladder, but I will endeavor to do all I can to further the interests of the Association, and try to turn over a new leaf and to show a little more interest than I have heretofore.

President.—Messrs. Shane and Zimmerman not being present, Mr. Montzheimer, I ask you if you accept the office of fourth vice-president to which you have been elected?

Mr. Montzheimer.—I thank you very much for the honor conferred upon me, and will do all I can as far as my ability goes to help the Association in any way that I can.

President.—Mr. Patterson, do you accept the office as secretary?

Mr. Patterson.—I do.

Mr. Lichty.—I believe the honorable gentleman deferred his speech until next year.

Secretary Patterson.—Gentlemen, I think the last party who spoke is entirely out of order and shows some ignorance, because we do not know what is coming next year, it is too far off to count on next year. I assure you, gentlemen, that I appreciate the honor bestowed upon me, and the many courtesies and pleasant greetings that you have given me during the last eleven years that I have occupied this position, and it certainly gives me great pleasure to feel that I have your confidence to such a great extent. It has been my effort to issue the Proceedings promptly and in good shape, and to conduct the business of my office for the best interests of the Association.

President.—I think all of us fully appreciate the efforts you make in our behalf.

President.—Mr. Thompson, you have been elected treasurer of this Association, do you accept the office?

Mr. Thompson.—I do, and will put forth my best efforts to do my duty and keep the money safely.

President.—The members of the Executive Committee not all being present, Mr. Austin, you have been elected a member of that committee, do you accept the position?

Mr. Austin.—I will.

President.—Mr. C. A. Lichty, you have been elected a member of the Executive Committee, do you accept?

Mr. Lichty.—I am pleased to accept the honor, Mr. President.

President.—Mr. J. H. Markley, you have been elected a member of this committee, do you accept?

Mr. J. H. Markley.—I accept and thank you all for the honor bestowed upon me.

President.—You have heard the responses of the various officers present whom you have seen fit to honor with your vote at this time, and the very fine remarks from them, and I will not worry you with any set speech except that I do wish to say a few words to you, as man to man. I am no orator, you all learned that long ago, but I want to say a few words, that come from my heart, to you. While they will not be just correct according to the best rules of rhetoric, they do not come from the head but come directly from the heart, and I assure you that no man could possibly appreciate the honor which you have bestowed upon me more than I appreciate this honor. I have learned to trust the judgment and united opinion of this Association and value it highly, but I feel, gentlemen, that in this instance you may have made a mistake, but certain it is that I will do the very best possible. I will devote all the energies of which I am capable for the prosperity and success of this Association for the coming year. I have several thoughts which I would particularly like to impress on you in regard to our work. It is a lamentable fact that our committees have not been as well supported as they ought to be. Now it is perhaps very bad taste for a new president to begin to scold the first thing, and I do not intend to scold, but it is like this, these committees which I will appoint for investigation of the various subjects which you are pleased to discuss,

hold a very important relation to the success of our Association. The chairmen of these committees have, as a rule, a large portion of the work to do. I think that is not just right. I think every member of the various committees should feel an equal responsibility with the chairman. I think more than that, gentlemen, that every member of this Association should feel a great responsibility to do his part to enable the various committees to secure all the information possible on the subjects assigned. At our last convention our past president and worthy member, Mr. Walter G. Berg, said he had noticed by his experience "that the success, or the rise and fall of an association, was very much in accordance with the work of its secretary." We all appreciate the importance of a good secretary. We all appreciate the importance of official members being earnest and active and doing their part, but do we also feel that we individually are responsible for the success of this Association? And in regard to the above committees let me ask you, please, every member, and I sincerely wish that every member of the Association could hear my voice while I make this request, do all you can to accommodate the committees this year. None of us are so busy but what we could find a little time if we wanted to, to secure some data or some information to send to these committees, and it will be a great benefit to them, and of far greater benefit to the Association. So let me impress this so strongly that each of us will feel a personal responsibility for the success of the Association. There is another point that I wish to emphasize, and think we have had it somewhat illustrated both in this Convention and in the Convention held in the South last year, and that is the importance of missionary work. We have a grand Association; I think you will all agree with me in this, and I think I am not vain when I say one of the very best technical associations in this country. There are a great many men eligible to membership who would be glad to become members if they only knew the real facts in regard to our Association. We have had a beautiful illustration of what a little missionary work will do as it did last year at Atlanta, and this year by the great number of new members in this Northwest country

who have come in through the earnest efforts of one or two interested members. But, gentlemen, we have just such men all over this country. I have them on my own system. We each of us most likely have certain friends that are not now members, but who are eligible to membership in this Association. We do not want to be selfish about the good things of this life; we have a good Association and derive great benefits from it ourselves, and now let us go out and impress the importance of the benefits to be received from this Associa tion on the men who are not now members and bring them in, in order that we may not only increase our membership but will secure their services and coöperation so that in the end the result will be that the standard of the bridge and building department all over this country may be raised very materially by our united effort in this direction. Thanking you for your patience in listening to my broken speech, we will now turn to the regular business of the meeting.

President.—The next matter to be brought up for attention is deciding on the place of meeting for the next convention; and just let me say, gentlemen, that our time is limited and that we will have to determine this quickly. I await your pleasure.

The secretary read invitations received to meet at Buffalo, Niagara Falls, Cleveland, Detroit, and St. Louis.

The following cities were then nominated as places for holding the next annual convention of the Association: Quebec, Pittsburgh, and Buffalo, and upon ballot being taken Quebec received twenty-four votes, Pittsburgh three, and Buffalo nine. Total, thirty-six.

President.—Quebec having received the majority of the votes cast, it will be our next meeting place.

Mr. Cummin.—In regard to holding the usual meeting of the Executive Committee after the close of the Convention, inasmuch as all of our time has been provided for before we leave the city, I move that we hold the meeting of the Executive Committee on the train on our way to Duluth.

Mr. Mallard.—I second the motion.

Motion carried.

President.—I believe there are still one or two items not yet acted upon, but the time is passing rapidly and we will have to move quickly.

Mr. Cummin.—I notice on the programmes sent out for this meeting that that notice stated that for this Northern trip the sleeping car accommodations would be furnished by the Association. In order to bring the matter properly before the Association and to have a correct record I move, Mr. President, that a draft be drawn on the treasurer for whatever amount may be necessary to provide for these sleeping cars.

Mr. Stannard.—I second that motion.

President.—Gentlemen, you have heard the motion that a draft be ordered on the treasury for the amount necessary to provide the Pullman transportation for the trip to Duluth and the Iron Ranges. As many as favor that motion please manifest it by saying Aye; opposed Nay. Motion prevails.

Mr. Lichty.—There is one question I would like to ask of some one who knows, and that is, what lines running into Quebec operate their own sleeping cars.

Mr. Killam.—The Grand Trunk operate the Pullman; the Canadian Pacific Railroad and the Intercolonial operate their own sleeping cars.

Mr. Killam.—There is one great attraction that I think will influence the members to go to Quebec, and that is, there is in process of construction at the present time a very notable bridge with the longest single span of any bridge in the world. I think it is a nineteen hundred foot span, and we will arrange for the steamers to take us right up so we can see this bridge.

President.—Gentlemen, if there is no further business a motion to adjourn will be in order.

Mr. Stannard.—I move that we now adjourn to meet in Quebec on the third Tuesday of October, 1903.

Mr. Markley.—I second that motion.

President.—As many as favor that motion please say Aye.

The motion prevails. The Convention stands adjourned to meet in Quebec on the third Tuesday of October, 1903.

S. F. Patterson,
Secretary.

Supplemental Report on Turn-tables Operated by Hand Power.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

At the last annual meeting of the Association held in Atlanta, Ga., October, 1902, the question of turning engines by hand power was referred to me, as a committee of one on this subject,

I have made investigation in reference to this matter. At our own shops at Danville, Ill., I find, in conversation with men in charge of that part of the work, that an average of 75 engines are turned in 24 hours. The hostler and one helper take the engines out of the house, give them sand, water, and coal, when necessary, and prepare them for the out-going trip. The hostler and two helpers put the engines in the house, and, in addition to this, clean the fire, clean out the cinder pits, and do other work in connection with putting the engines away, which include turning the table. In both cases these helpers are paid $1.37\frac{1}{2}$ per day. The two helpers who assist the hostler in putting the engines into the house are taken from their work at the cinder pit about ten minutes for each engine. Assuming 37 engines out of the 75 went into the house, the cost of handling the table for them would be $13\frac{1}{3}$ hours at 11 cents, or $\$1.49\frac{1}{2}$. The helper who assists the hostler in taking the engines out is taken from his work, wiping in the round house, about five minutes for each of the 38 engines taken out, which would cost $3\frac{1}{6}$ hours at $11\frac{1}{2}$ cents or $36\frac{1}{4}$ cents. By this we see the 75 engines are turned by hand at an average cost of $1.77, or $0.0237 for each engine.

A. S. Markley,
Sup. B. & B., C. & E. I. R. R.

Supplemental Report on Turn-tables Operated by Steam Power.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

We herewith give a sketch showing the various connections for operating the turn-table at Huntington, Ind., on the Erie Railroad. This is a 65-foot table and is now equipped and operated by steam at a total cost of $140.90. Of this $102 is for labor and $38.90 for material.

The engine used in operating this table is an old 14 horse power, vertical engine, which had been considered as obsolete and of no value for the past twelve years. When our master mechanic, Mr. J. G. McLaren, conceived the idea of operating the table by some other power than by hand he examined this engine and found it could be put in use at a small expense and went ahead with the work with the very best of results. The table can be operated successfully with twenty pounds of steam but they generally use thirty pounds. There is no trouble whatever in the handling of our heaviest engines which weigh about 316,400 pounds.

The steam which is used in the operation of this table is taken from the stationary boilers in the roundhouse and so far there has been very little if any increase in the amount of fuel used under these boilers. Before this power was installed the cost of operating the table was $180 per month; of course some of this would be chargeable to cleaning up around the table and radial tracks. Since the installation of this power the expense has been reduced to $90 per month; one man during the day and one man at night.

You can readily see what a reduction of expense this means in one year and there are few railroads but what have an old engine considered as obsolete that could be fitted up and made useful in the manner stated in this report. This table has been in operation in the above manner for about six months and there has been no failure in its operation in any manner.

W. O. Eggleston,
Master Carpenter Erie Railroad.

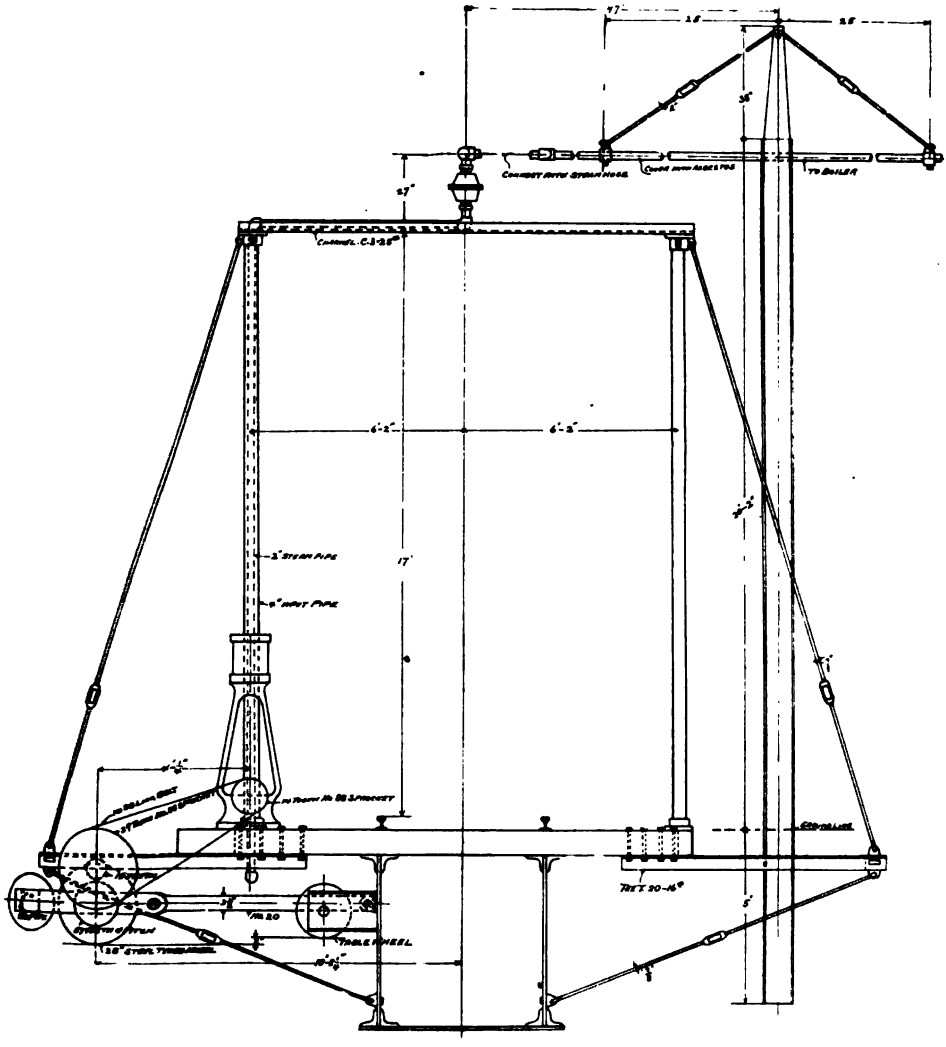


FIG. 1. Steam Power Attachment to Turn-table, Erie R. R.

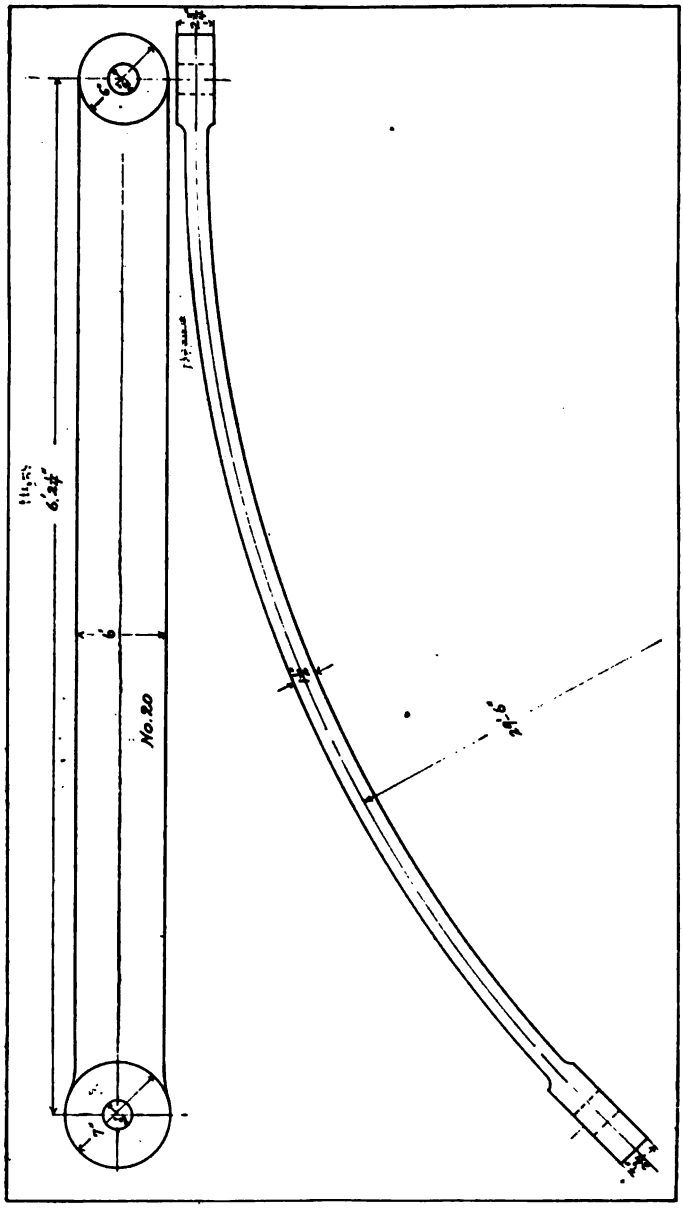


FIG. 2. Steam Power Attachment to Turn-table, Erie R. R.

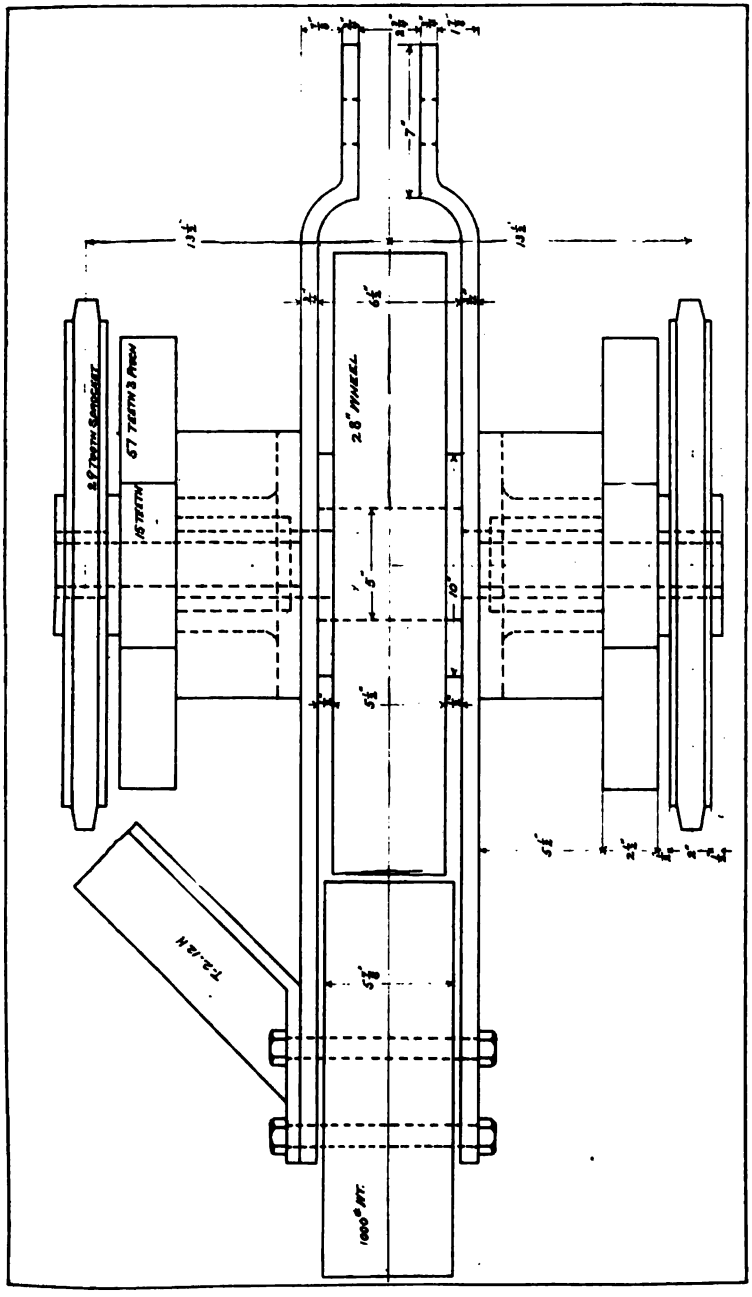


Fig. 8. Details of Steam Power Attachment to Turn-table, Erie R. R.

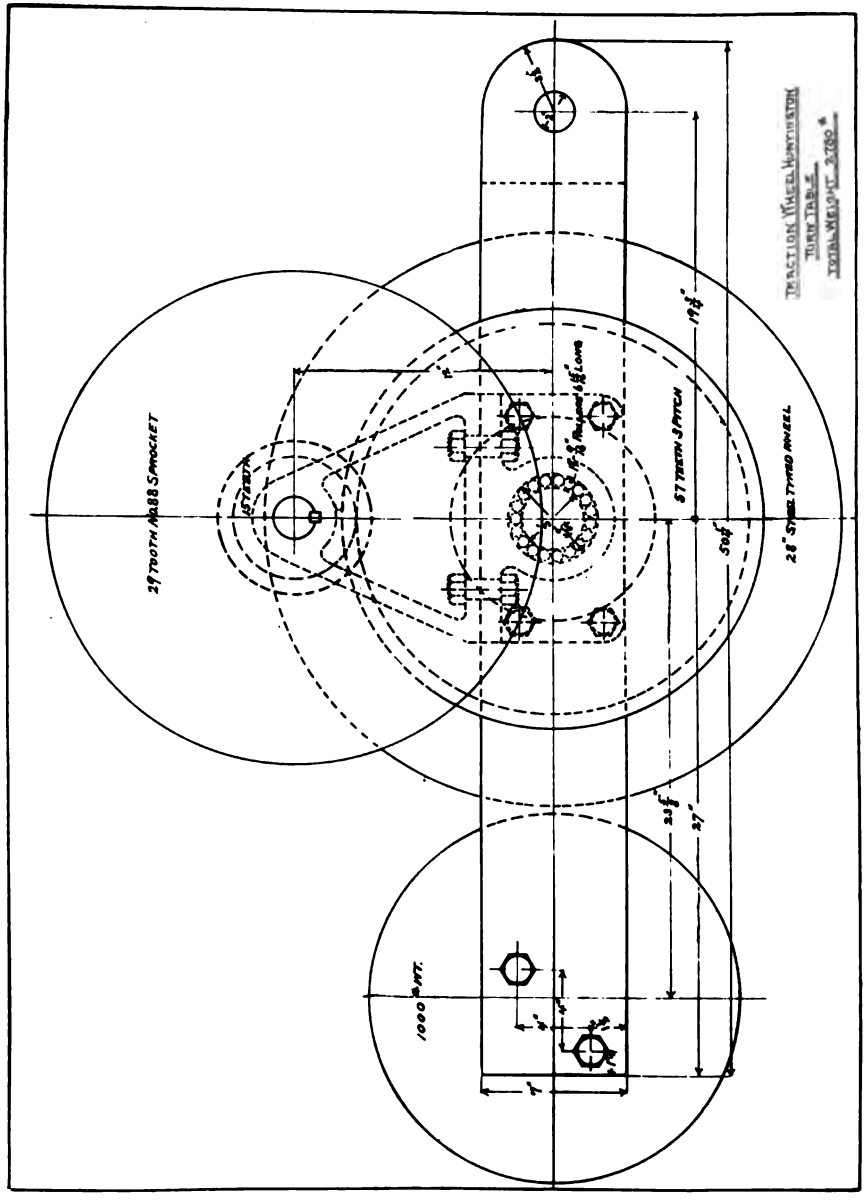
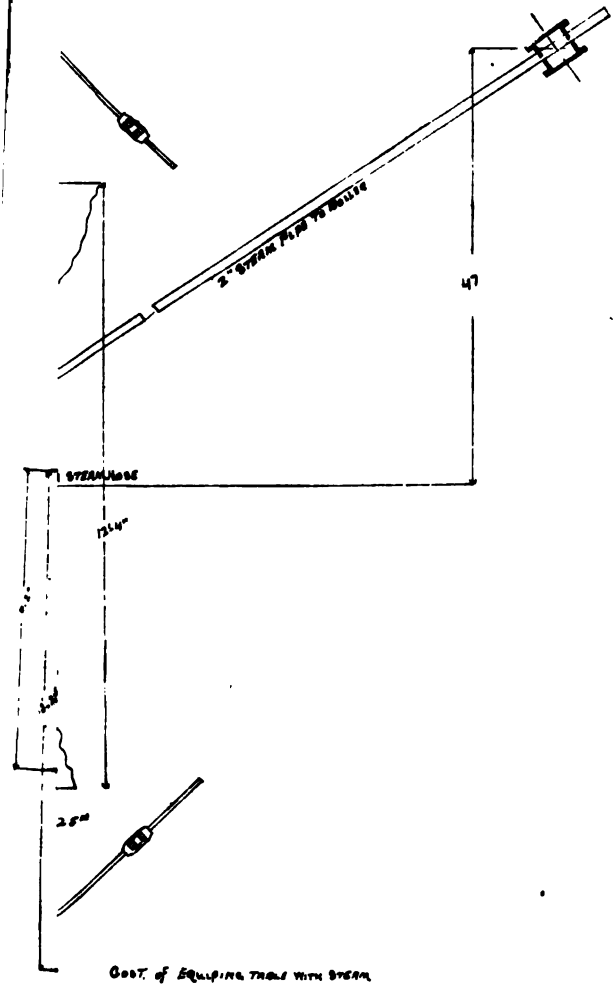


Fig. 4. Details of Steam Power Attachment to Turn-table, Erie R. R.



COST of EQUIPING THOLE WITH STEAM

LABOR — 102 10
MATERIAL — 3090
19200

Supplemental Report on Cost of Operating Turn-tables by Power.

To the Association of Railway Superintendents of Bridges and Buildings:

In my report to the Association last October, I stated that the Lehigh Valley Railroad Company had one gasoline engine in service operating a 64-foot diameter turn-table at Coxton, Pa.

Since that date this company has installed four additional gasoline engines and one electric motor for operating turn-tables. The gasoline engines are Fairbanks Morse Co., 5 H. P. engines. The electric motor is 20 H. P., manufactured by the General Electric Company. The total cost of installing a gasoline engine apparatus is about $1,100. The total cost of installing electric motor apparatus is about $1,150. The economy of operating the turn-tables by power depends on the number of engines required to be handled at a certain point as the following records of expenses for various turn-tables will show.

64-*foot turn-table at Coxton, Pa., 5 H. P. gasoline engine, installed July*, 1901.

Average number of engines turned per day of 24 hours in a period of one year, 174.
Average cost per engine turned in a period of one year, $2\frac{21}{100}$ cents.
Average cost of labor and material operating turn-table per day of 24 hours, $\$3\frac{78}{100}$.

75-*foot diameter turn-table at Lehighton, Pa., operated by 5 H. P. gasoline engine, installed February* 12, 1902.

Average number of engines turned per day of 24 hours, 121.
Average cost per engine turned, $2\frac{9}{10}$ cents.
Average cost of labor and material operating turn-table per day of 24 hours, $\$3\frac{41}{100}$.

75-*foot diameter turn-table at South Easton, Pa., operated by 5 H. P. gasoline engine, installed March* 14, 1902.

Average number of engines turned per day of 24 hours, 188.
Average cost per engine turned, $1\frac{97}{100}$ cents.
Average cost of labor and material operating turn-table per day of 24 hours, $\$3\frac{74}{100}$.

75-*foot diameter turn-table at Wilkesbarre, Pa., operated by 5 H. P. gasoline engine, installed March* 18, 1902.

Average number of engines turned per day of 24 hours, 46.
Average cost per engine turned, $6\frac{5}{10}$ cents.
Average cost of labor and material operating turn-table per day of 24 hours, $\$2\frac{91}{100}$.

75-foot diameter turn-table at East Buffalo, N. Y., operated by 5 H. P. gasoline engine, installed April 1, 1902.

Average number of engines turned per day of 24 hours, 103.
Average cost per engine turned, $3\frac{37}{100}$ cents.
Average cost of labor and material operating turn-table per day of 24 hours, $\$3\frac{41}{100}$.

64-foot turn-table at Sayre, Pa., operated by 20 *H. P. electric motor, installed June* 1, 1902.

Average number of engines turned per day of 24 hours, 109.
Average cost per engine turned, $3\frac{7}{10}$ cents.
Average cost of labor and material operating turn-table per day of 24 hours, $\$4\frac{1}{100}$.

The above average figures of cost do not include the interest on first cost of plants, nor any depreciation of the plant. These items will amount to about 45 cts. per day.

F. E. SCHALL,
Bridge Engineer, L. V. R. R.

DISCUSSION OF COMMITTEE REPORTS

FOR 1900-1901.

CONTINUED FROM ELEVENTH ANNUAL CONVENTION.

I.—Best Method of Operating Turn-tables by Power.

Mr. Schall.—In regard to the report of Mr. Markley about operating turn-tables by hand, as he has stated in his report, at a cost of $1.77 per day, for two men, assuming 10 minutes for turning each engine, I should differ with him on the time consumed in turning seventy-five engines, unless he could get the seventy-five engines lined up near the turn-table and turn them one after the other. I doubt very much if the men who are employed at other work will go to the turn-table, turn the engine, and go back to their work on an average time of ten minutes per engine. In my opinion it will take the men not less than 15 minutes for turning each engine including the time consumed in going to and from the table. On this basis the cost would be as follows:

2 helpers for 37 engines, at 15 minutes each, 18 ½ hours at 11 ½ cents	$2.12
1 hostler, 1 helper, 38 engines at 15 minutes, 19 hours at 11 ½ cents	2.18
Total cost per day	$4.30

Our reports should state the facts, and I dare say if the report is published as submitted the managers will see it and think there is something wrong with the men where the operation of turn-tables costs so much more money, and I should

like very much if Mr. Markley would revise his figures in such a way that they would be more in harmony with the facts.

As to Mr. Eggleston's report about installing that steam plant for operating turn-tables, the figures that I gave last year for installing power apparatus are absolute charges; there is no juggling of the figures, they include all the material, labor, and whatever is necessary to do the work; they include the apparatus complete, and cost us from one thousand and fifty dollars to eleven hundred dollars for each turn-table plant. Mr. Eggleston states that his steam apparatus costs his company one hundred and forty dollars; the report is no doubt correct as to the cost of his turn-table apparatus, but when you present reports before an Association of this kind we are not supposed to look around for old material, and it is not right to say "I get this thing for nothing," but should state what the apparatus will cost using new material, and I believe that all reports should be based on the principle of having to buy everything. It is not every one who can put a steam engine apparatus on a turn-table for one hundred and forty-six dollars, not having an old engine for disposal without charge, nor the steam supply ready for use. I am sorry that the report was made in this way, and I hope that Mr. Eggleston can put his figures in different form by estimating value of new plant. You would have to pay at least three or four hundred dollars for an engine that would do the work properly. I again say reports of this kind should be based on new material, for the guidance of members who are not so fortunate as to be able to obtain old material without charge.

Mr. Markley.—Would like to ask Mr. Schall what he pays his men.

Mr. Schall.—Thirty-five to forty dollars a month.

Mr. Markley.—Answering Mr. Schall, would say that during the past two or three years we have been putting in new and improved turn-tables with center bearings on four-inch rollers, and on them one man can turn our heaviest engines. This is being done regularly. The men who turn the engines clean out the ash pits, load the ashes on cars by hand, and also give the engines sand, coal, and water. The hostler who

handles the engine very rarely gets off to assist in the turning except in bringing them out of the house, when it is his duty to assist. In the revised draft of my report, which will appear in the Proceedings, I figure on ten minutes being required to turn each engine; on this basis 240 engines can be turned in twenty-four hours, using the men continuously. When a less number of engines are turned in twenty-four hours, the railroad company will get the use of the men for other work for such time as they were not turning. The advisability of using power depends on how far the cinder pit, sand house, etc., are located from the turn-table. When all the appliances are sufficiently close together, say within 500 feet, the men will not be long delayed going to and from the table to turn engines. It is economy to use power when the cost to turn by hand nearly exceeds the cost to turn by power, taking into consideration the cost of installation of the power, its maintenance, the interest on money invested, and the depreciation, none of which occurs when hand power is used.

Mr. Schall.—It would not pay to put in an engine and machinery where you have only a limited number of engines to turn, but where heavy amount of power is turned it will pay to put in machinery; where we have power installed we know absolutely that we show a saving of from forty to forty-five dollars a month, which we consider a pretty good return on the investment, but it does not pay to install the power where you only have a limited number of engines to turn in a given period.

Mr. Markley.—Mr. President, I agree with Mr. Schall that it depends upon the number of engines turned whether it pays to install this power or not, but I want to ask Mr. Schall how about cleaning the fire and the other work in connection with putting his engines away.

Mr. Schall.—Mr. President, about the cleaning, I would say we have our heaviest power at Coxton, where we have had a gasoline engine for turning the turn-table in use a little over a year, right at the foot of our heaviest grade. The "mountain pushers" that come in turn and go right out again; they do not take the engines into the house, except for special small repairs and cleaning at certain periods.

Mr. Killam.—In reference to this matter of turning engines, on the Intercolonial Railway of Canada we have some thirteen turning stations, and in no place have we adopted the power other than hand power for turning. The men who are in the shops clean the pits and do various other work besides turning the locomotives, and the time which is consumed in turning the locomotives is scarcely taken into account at all, because at no station do we turn as many locomotives as many of the roads that are represented here. This matter of putting in power at some of our larger turning stations has been discussed, but they have not yet adopted any power. At present two or three men usually turn the engines. Our engines now, except a few, are all those large class of engines, two hundred and fifteen to two hundred and fifty-five thousand pounds, and the freight engines two hundred and sixty to two hundred and eighty thousand pounds, ten-wheel drivers, but two or three men turn the engines that we have, and as I said before, the cost of turning has never been discussed or taken up with us, so far as I know of. In a general way the men are called from some other work, or standing idle, and if an engine is to be turned they take hold and help turn it.

Mr. Powers.—Mr. President, I would like to say that the companies I am working for each have an electric table at terminal points. I have taken up the matter of operating and maintaining tables with Mr. Honigan, our master mechanic, as he has charge of them, and he advises the cost of operating can hardly be considered as the handling is done by the hostlers, where with the old table he had to use laborers to assist in turning engines. At Joliet there are about sixty engines turned daily. We pay twenty dollars a month for power, but it will be a hard matter to say what the cost of maintaining would be as there was never an accurate account of this, but Mr. Honigan advises it would positively not exceed ten dollars per month. He thinks my figures are moderate in this matter.

Mr. Pickering.—I shall agree with both my friends, Schall and Markley, because I have had a little experience both ways. I think Mr. Markley's stand is well taken, in that, in many

small places where there are not a great number of engines to turn there are men employed whose other duties call them there, so that the matter of turning engines is not an additional expense; these men would be employed just the same if we turned the engines with power. And again, we have other points where, if we would have to turn our engines as Mr. Schall suggests, it would be very much cheaper to install power, but instead of that we have the double-end engine and that runs both ways and we don't turn them. In some places it would not be a very great saving to employ power for turning engines, because it would be necessary to hire additional help for that purpose, but on the other hand, we have many points where it costs nothing additional for turning the engines.

I think Mr. Schall's point is well taken in regard to Mr. Eggleston's report. The idea of all the material for turning a sixty-five foot turn-table, such as he speaks of at Huntington, Ind., on the Erie railroad,—that material only costing thirty-eight dollars and ninety cents. It is absurd! Of course I do not question Mr. Eggleston's veracity in the matter, but you see he is putting in this engine, which he considered obsolete, as valued at nothing, but all of us are not so well blessed with these things and do not have these old engines. We have to buy something new at a cost of several hundred dollars usually. If we do not explain these things, and our managers get hold of these reports they will say, Well, here, Mr. Schall, you are expending $1,100 or something like that for equipping turn-table for power while the Erie railroad company equips their turn-table for $140; what is the matter with you? I, therefore, think the point is well taken. If we use old material, we should consider that fact and report just what the new material would cost if we had to go out in the market to buy it, and make our report on such a basis, as otherwise they may be very misleading.

Mr. McGonagle.—Some matters come up at these discussions where statements are made that are quite at variance, such as in the present instance in regard to the cost of turning these locomotives, and I think it would be well for Mr. Schall and Mr. Markley to get together and try to arrive at a conclu-

sion that will give us some definite and satisfactory information. At Two Harbors you will see, when you arrive there, a turn-table operated by compressed air power, and a very satisfactory device. This device was rigged up by taking most of the material from a disabled steam shovel, and using other old materials. There are a number of features in connection with this matter of turning locomotives by power that are worthy of consideration outside of the matter of cost, and one is, as Mr. Schall states, the matter of getting engines when you want them. When you want a locomotive you want it badly and want it to go without delay. It is difficult to determine the very small cost of operating that particular turn-table at Two Harbors. It simply happens that the turn-table is located near the compressed air-plant and for that reason it is the cheapest power for turning that table. Now I believe where fifty engines are turned in twenty-four hours it pays to put in a turning device by power. It is the question of getting your engines quickly. I don't believe it would pay to put in an independent electrical device or steam device, but do believe it pays to put in any kind of device that can be used for some other purpose. I think you gentlemen will see a device at Two Harbors that will show you the possibilities of compressed air for turning locomotives.

Mr. Markley.—We have no difficulty in getting engines when we want them, we always get them when we want them, and they are always ready to go; we turn seventy-five engines a day at Danville, and in addition to turning the engines these men clean out the ash pit, etc. As for using old material I replied to that last year, and don't care to say anything more now.

Mr. Montzheimer.—At Chicago we have a turn-table that is turned by electric power which is gotten from the dynamo in the shops, being installed there to light the shops and do other work. In this way the extra power for turning costs but very little. Previous to this we turned it by hand, by two men days, two at night; since then one day, and one man at night, which shows a saving of over eighty dollars a month. Furthermore it was almost impossible to do the necessary turning by

hand, as we turn three hundred and seventy-eight engines per day on that table in twenty-four hours. The suburban engines are turned several times each day; just come in and turn them and run right out again.

Mr. Lichty.—There is another point on the Northwestern where not so many engines are turned as that, where they depend upon the shop men working in the house to help turn them. When they want to turn an engine they start the steam whistle for help, but they had to whistle so much that the people in the neighborhood made complaint in regard to it. They had to whistle quite often before the men would come on account of being busy at something else. That is where some kind of a mechanical device would be best, as it is always ready and needs but one man.

Mr. Schall.—I just want to say for Mr. McGonagle's information that my figures are the absolute charges for turning engines, pay-roll expenses, gasoline, and everything, and for the table operated by electrical power the proportionate amount of the 20 horse-power motor to the cost of operation of power plant is charged to the table, and also the proportion of the wages of the engineer running the generators. These figures are very carefully compiled.

Mr. Markley.—How long, Mr. Montzheimer, does it require to turn one of your engines. If three hundred and seventy-eight engines are turned in a day of twenty-four hours, you would have to turn an engine in slightly over three and a half minutes.

Mr. Montzheimer.—We can turn about one engine per minute and a half.

Mr. Cummin.—I haven't anything to say on the subject of turning turn-tables by power, but I have a large drawbridge that we used to keep four men on continually, two at day and two at night. We installed electric power and now have just one man at day, and one at night, and save ninety dollars a month. We just simply attached a wire to our trolley line; we do not consider that cost at all.

II.—Method of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under.

Mr. Reid.—With reference to this subject would say that on the Lake Shore we have put down several piers and abutments in water, shallow water, twenty feet deep, by using the Wakefield sheath piling, and then excavating with the help of a pump; using the pump to keep the water down, and have never had any trouble in getting foundations down.

Mr. Mallard.—Our method is just about the same except that we do not use Wakefield piling. We use T. & G. material, making the T. & G. by nailing strips on the edges of the plank. In one small structure that we put up recently the piers rested upon a pile foundation. In driving the piles instead of using the regular pile driver, as we had to erect a derrick and hoisting engine to place the stone, we simply hung a pair of leads from the end of the boom and let them down into the cofferdam, and drove the piles in this way.

Mr. Sheldon.—We have had some experience in putting foundations in water less than twenty feet, but we simply drove tongue and grooved sheat piling and filled the space inside full of piling, using timber, grillage, or concrete to distribute the bearing over the entire surface.

III.—Passenger Platforms at Way Stations, Best Material and Cost of Same.

Mr. Sheldon.—As a member of the committee making the report on this subject last year, I can say that the cost and durability given was based on information from various parts of the country. From practical experience with nearly all kinds mentioned in that report, I am satisfied that a platform made of coal tar concrete for all ordinary service is best, being low in first cost, safe, durable, easily kept clear of snow and ice, and most economical in the end.

Mr. Pickering.—Mr. President, I would simply state that it is a very important matter with us, but I have nothing to offer in addition to what I said last year, with this exception.

I had occasion to build a platform at a new station, a small local point, and we tried something entirely new between the two tracks, which is giving us good satisfaction and we are very much pleased with it. It was simply granite chips where we make paving blocks in our quarry; we screened them, using very fine chips on top rolled down with a heavy roller, and it is giving wonderfully good results. I did not anticipate that it would do so, but as the work was done in connection with some other work we did not keep tab on the cost of it, so I cannot give you the cost, but it certainly has proved a very successful platform and we know it is indestructible, will not rot, rolls down very hard, in fact, so hard that it is almost as solid as granite, does not track up or become rough; another very nice thing about it is, between the double track it can be taken up and the ties renewed, put back, and rolled down again without any deterioration of the material. If anybody else has had any experience would like to hear from them on that line.

Mr. Smith.—We build a great many platforms out of stone screenings from Stone City. They pack down and make a platform that is next best to our brick platform, and away ahead of the common cinder and clay mixed platform.

Mr. Cummin.—I would state, Mr. President, that at a number of places on our road we used granite screenings for platform tops, but do not make the entire platform of that material. Put hard coal cinders down first and roll them down with heavy rollers and then put the granite screenings on top. We have had very good success with them.

Mr. Canty.—I am on the same road as Mr. Pickering, but would state there are some criticisms to be made on use of granite chips or broken stone for station platforms. We have used broken stone quite extensively at small stations, but agents say that people track particles of stone into buildings and a good many nice floors are marred thereby.

Mr. Cummin.—That same point came up several years ago, when this subject came up at that time, but at the place where we used them there is no station. The main thing is to get the passengers on the trains and get them home again after the

races are over. We have a few other places where I have used them between the tracks and where platforms are of extreme length, at the ends, but none immediately around our buildings.

Mr. Pickering.—If the screenings were thoroughly rolled down I do not think there would be any trouble with them. At this point I speak of we have a maple floor in that station, and so far (this platform only having been down six months), no indication of tracking into the station whatever. I do not know how it will be in the winter season.

Mr. Reid.—Do you put the screenings in without any bond or cement? Do they form a bond themselves?

Mr. Pickering.—Yes, sir.

Mr. Canty.—In answering Mr. Pickering's question I will say we use broken stone, pea size, covered with stone dust. This is sprinkled with water and rolled thoroughly. Nevertheless it has been considered advisable to provide mats for people to clean their shoes before entering stations where it is used. While this is a cheap and durable style of platform, it is not wholly satisfactory.

Mr. Pickering.—Perhaps our success was due to the kind of material used, as I said in my first remarks it was chips from making paving blocks. It is not the ordinary crushed stone that I referred to, and the base of this platform is composed of the coarser material, the very fine material being sifted out for the top. Then again, this is between the two tracks. The platform adjoining the station is made of tar concrete and I presume that may make some difference in the tracking, because it gives them time enough to track the granite off their feet before they go into the station.

Mr. Sattley.—Would like to ask Mr. Pickering if he can use trucks on this platform that he speaks of. Can you use them satisfactorily in rainy weather Mr. Pickering?

Mr. Pickering.—Oh, yes. Would state that this platform had not been laid a week when a "Wild West Show" came to town. The platform that I referred to was at a suburban point of one of our cities, and they unloaded this "Wild West Show" just above this station and drove their horses right

over this platform, and if it will stand that it will stand most anything.

Mr. Sattley.—We have had some experience with crushed stone and in every case that I know of have had to replace the platforms on account of the trucks they are using rolling up the stone, causing it to be tracked into the cars. It is a failure on our road.

Mr. Staten.—We use that kind of a platform all over our road, and the agents kick and growl about the trucks running hard and we just let them growl, and go ahead and build them.

Mr. Smith.—As Mr. Cummin states, we fill with the cinders first and put these crushed stone screenings on top for a dressing, the cinders are rammed some, and as the platform settles down we put in a little more screenings to level it up.

Mr. Montzheimer.—We put in a platform of a little different construction and it is proving quite a success and only costs about six cents a square foot. In the bottom we put in cinders, roll them, then four inches of coarse, crushed stone, and two or three inches of limestone screenings on top mixed with cement, thoroughly rolled. I think it is a very economical platform, a safe platform, and I think as durable as anything except brick.

Mr. Large.—I have had considerable experience with these limestone chip platforms, and certainly my experience is not very favorable. When it rains they get soft and track up and stick to the truck wheels and the people's feet, and they are carried into the station, as some one has said, and ruin the floor, and while they put down one of them occasionally, yet they do it against my protest. I do not approve of them at all. The standard platform on the Lake Shore now is paving brick, with asphalt filling, around the station and also for the extension, using 8-inch stone curbing all around the free edge of pavement. This costs us about a dollar a square yard, including curbing. Between tracks we use plank platform.

Mr. Markley.—I notice on page 76 of last year's proceedings the remarks that I made at that time as to the cost of the brick platforms. We use the No. 2 paving brick, size three

inches by four inches by nine inches, and at that time the cost was three cents per square foot and two cents additional for labor laying them. It depends altogether upon the character of the ground how much you will have to fill. You cannot judge one job by the other excepting as to the laying of the brick.

Mr. Sattley.—Brick at eight dollars per thousand, everything included, costs about ten and one half cents per square foot; at ten dollars, about twelve to thirteen cents per square foot for brick laid on edge. And that is as cheap as it can be built.

Mr. Markley.—What size brick?

Mr. Sattley.—Common size brick, two by four by eight inches, laid on edge.

Mr. Markley.—We use large paving brick, three inches by four inches by nine inches.

Mr. Smith.—We have built quite a number of platforms, brick on edge with wooden curbing, and the average cost was eleven cents per square foot. Last summer some of the concrete curbing was used for platforms and we have put down quite a large amount of it during the past summer, but I have been so busy have not got at the cost of those platforms, that is, the cement-curbed platforms.

Mr. Stannard.—We have just finished a large platform at Brunswick, Mo. Cost of brick work was about 8⅛ cents per square foot. This does not include cost of filling or curbing. From 8⅛ to 12 cents would be a fair average cost per square foot, which cost would depend largely on amount of filling. I would recommend brick well laid in preference to any other kind of platform, and as cheap at first cost as platform constructed of three-inch plank.

Mr. Large.—We use what we call paving brick, 4¼ by 8½ by 2¼ or 2½ inches, but laid flat and use stone curbing. We pay thirty cents per foot for 24-inch and forty-five cents for 30-inch curbing. It is all dressed curbing ready to put down. It costs about eighty cents per foot to set it.

Mr. Pickering.—We get out our own curbing. It costs us about thirty-five cents per foot. We do not use anything

over 24 inches deep. Think that is deep enough. We lay all platforms level with the top of the rail.

Mr. Killam.—Mr. President, on our road we have very few platforms that are not built of wood and covered with 3-inch plank. They are put down eight inches above the top of the rail and laid on cedar foundations, but there is no doubt about the concrete platform being the best platform that you can put down.

Mr. Rettinghouse (by letter).—I regretted very much to be absent in Convention hall at our Minneapolis convention during the discussion of the report on "Passenger Platforms at Way Stations: Best Material and Cost of Same." I send you, therefore, as a written discussion, such notes as I was prepared to deliver verbally in connection with my remarks on the subject made at Atlanta the year before.

The experiments made by us during the year 1901 in building cinder concrete platforms did not come entirely up to expectations in so far as the hardening of concrete is concerned, and after experimenting further in a small way with different proportions we finally decided on a proportion of one part of cement, two parts of sand, and three parts of cinders. It must be remarked here that certain conditions are absolutely necessary in the making of a good cinder concrete, the conditions being good fresh hydraulic cement, clean and coarse sand, and good coarse locomotive cinders. The latter should be washed and as much as possible cleaned from all dust. The results so far have come up fully to all expectations, and platforms so made have a good hard surface. We use either good second-hand 8x16 stringers, or new 4x12 plank for curbing, tying them transversely together with 6x8 second-hand bridge ties. This season we have built twelve new platforms as per above, and on all excepting two we placed a strip of 3-inch planking, 4 ft. 6 in. wide, along edge of platform. This was done for the purpose of avoiding of breaking up of concrete surface in unloading baggage and freight. On the other two platforms referred to, instead of placing planking along the edge I placed concrete of same proportion as balance of platform, using, however, Portland

cement for this part instead of hydraulic. This experiment has also given good results, and we have decided to follow this scheme in the future. The average cost of such platforms complete, including tearing out of old platform and plank strips along edge, the concrete part being six inches thick, was five cents per square foot. Concrete proper cost 3½ cents per square foot. Of course the cost depends a great deal on conditions in each case, the amount of square feet contained in each platform being the principal factor.

IV.—Water Stations; Best Material for Foundations, Tanks, Substructure, Connections, Capacity, etc.

Mr. Markley.—I do not know of anything to add in addition to what I have already said. We sent in our report and I know of nothing more to add to it, but I hope some of the members will have something to say, and criticise this report at this meeting or give us other information in regard to it.

Mr. Rettinghouse.—I think the system in vogue on the Chicago & Northwestern has been amply described, and we are using the same standard or blue print for water stations, with stone foundation, as illustrated in the plans that were submitted last year. We are all following the same plans.

Mr. Markley.—Would like to hear if any of the members are erecting any iron water tanks.

Mr. Stannard.—Mr. Mallard has an iron tank down at Morgan City.

Mr. Mallard.—We have iron water tanks and have had no trouble with them at all, except in the case of the one that you speak of. Our pump-house took fire and set fire to the creosoted joists that were under the tank and they were burned before the fire could be put out, but with no damage to the tank to speak of.

Mr. Killam.—Mr. President, our tanks are all built standard height, eighteen feet above the rail, on stone foundation thrown two feet above the rail. The tanks are all of a standard size except one or two on the road which are of one hundred thousand gallons capacity. We use stone, as I said before,

for foundations, but have no iron tanks. I do not know of any iron water tanks at the present time. There was one on the Canadian Pacific Railroad and it appeared to work well, but I understand they have taken it out; have not been there lately and have heard no complaint about it rusting, still there must be some difficulty in reference to the deterioration if they have taken it out. I know they painted it inside well with three coats of paint. We are using the wooden tanks altogether on the Intercolonial Railway, and we run a cast iron pipe up through the center of the tank through which runs a stove pipe to keep the water warm and prevent freezing, so that the tanks are always ready for use.

Mr. Mallard.—Would like to ask if any of the members have had any experience with corrugated iron water tanks; the Texas Pacific are using them, but I did not have time to communicate with the Gould system people. If there are any of them here they might be able to tell us something about it.

Mr. Staten.—In making the iron frames we use all of the old Phœnix bridge columns as far as they will go. Use a wooden tub just the same as we always did, but we are using iron all together for the frames, whether for renewing or for new ones.

Mr. Markley.—I would like to hear something on the corrugated iron tanks, where they are made; and would like to get some information about them.

Mr. Pickering.—I would suggest that Mr. Mallard be requested to furnish us the data, and that it be embodied in the Proceedings before they are published.

Mr. Mallard.—I will try and do so.

Mr. Thompson.—There was a tile tank put up some time ago, I think Mr. McIntyre sees it very often and I would like to hear what he knows about it as far as it being successful or not.

Mr. McIntyre.—I have seen the tank frequently but cannot tell you anything as to the construction of it. It is kept filled of course, all the time, and I think it is working all right. Mr. Clark reported on that a year ago.

Mr. Cummin.—For the benefit of the members I will state

that if they will read last year's Proceedings and Mr. Clark's remarks they will get all the information they want about this tile tank.

Mr. Thompson.—I will say in reply to Mr. Cummin's remarks, that I do not think the discussion of last year will tell us how this tank is standing the weather and use at the present time; that is what I want to know.

V.—Is it Best for Railroad Companies to Erect Their own Steel Structures, or Let the Manufacturers Erect Them.

Mr. Markley.—We had some iron bridge work to put in and we asked two iron bridge firms to bid on the work, and one of them bid $1,900 and the other $2,400. We concluded, in this particular case, to do the work ourselves, and it cost us $698.20. We had some advantage over the contractor by using pile driver instead of traveler to handle the work.

Mr. Thorn.—On the system that I am connected with, the Chicago, Burlington and Quincy Railroad, we have had a good deal of experience with the contractors and we have discontinued contracting anything excepting the very largest bridges, where we do not keep an outfit sufficiently large, but all ordinary spans up to two hundred feet we erect ourselves. We find that there is a certain amount of risk and we always have to pay the contractor for that risk on every job, and where you do it yourself you take your own risk, if you get through without any floods or ice or any trouble of that kind you save all of that, and we find it cheaper to do our own erecting. Another point comes up in connection with it, where you are using the structure and continuing traffic over it at the same time of erecting, you have to keep some of your own men there anyway, because you cannot always trust the contractors. You are therefore spending a lot of money that way and you might just as well have your own men doing the erecting. Ordinary spans two hundred feet long do not take a very big outfit, and we believe it best to erect them ourselves.

Mr. Powers.—We find the same experience on our line as this gentlemen, and so in order to facilitate the movement of trains we most always have to have on hand a bridge outfit to take care of the traffic while they are on the work in order to get the trains over the road, and at various places we have gotten figures from contractors and also submitted estimates on doing the work ourselves, and we have underbid them on nearly every job that they figured on, that is, outside of a peculiar or particular neighborhood. When you get inside of Cook county and conflict with the union then it is policy to let the union handle the business, but outside of Cook county we always found that it was economy to handle our own work.

Mr. Reid.—Our experience on the Lake Shore has been such that our officials refuse to allow any contractors to do any erection where we have to maintain traffic. We have very many, and very fast, trains, and in the past twelve years, since I have had charge of the bridge work, only two bridges have been built by contract work, a drawbridge at South Chicago, while traffic was diverted, and a drawbridge and three fixed spans over the Maumee river at Toledo, Ohio, which was heavy work, and required a larger outfit than we have. Where we do our own work the actual cost has been about one half a cent a pound for erection and riveting complete.

Mr. Powers.—We submitted a job for an estimate to a bridge company, and they wanted $14.75 per ton to put in the work and we to erect the false work. We put in the false work—it was a 60-foot girder—and our cost was $9.85 per ton, including the false work and all, so you see there was a big saving.

Mr. Sheldon.—There is one point where the railroads do their own erecting that has not been brought out, and that is we have found the bridges do not come always suitably fitted to put together, and there has to be cutting and fitting to get them up right, and there is liable to be trouble between the railroad company and the bridge company for any mistake in the work, as each one will try to lay it to the other.

Mr. Staten.—We do our own erecting, and have been doing

it for the last twelve years, and wherever we find a mistake like that the bridge company take water mighty quick and are always anxious to fix the matter up at once so we will not have a chance to say anything about it, and if we send in a bill against them for any extra work due to their mistake they pay it and do so without any trouble.

Mr. Cunningham.—Mr. President, I have been fortunate enough to have had experience both as a bridge contractor and as a railroad bridge engineer, and my experience is that the bridge contractor can erect bridges more cheaply than a railroad company. This is readily understood when you take into consideration the fact that erecting steel bridges is a very large part of a bridge contractor's business, whereas, it really does not enter into a railroad company's business at all. The figures that have been mentioned for erection at this meeting are greatly in excess of the average cost. It is a fact, however, that contractors are figuring at present nearly one cent per pound for erection. This is due to the fact that good bridge men are receiving at present very high wages, the union scale being 50 cents an hour for every man, good or bad, on the job for a day of eight hours, and over time at the rate of 75 cents an hour. Small plate girders can certainly be erected by railroad companies more cheaply than by bridge companies, but where you have pin connected bridges and large riveted structures, you will find that the bridge contractor's proposition will be a great deal less than that for which the railroad company can do the work. If you have an old structure to replace by a new one, it will certainly not pay the railroad company to take down the old structure and allow the bridge company to erect the new bridge, because there are then two travelers to be erected and paid for. I believe it to be a great deal cheaper in this case to let the total contract to the bridge company both to remove the old and to erect the new structure.

VIII.—The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang.

Mr. Reid.—Do not know whether this information will be new or of any benefit, but I have eight bridge outfits on the road, each with a set of cars, and in each set have a dining car, sleeping car, tool car, and a blacksmith car; use a flat car for the blacksmith car, and the tool car is fitted up with racks, etc., for tools and supplies. In the dining car we have the kitchen in one end, and dining table in the balance of it; and in the sleeping car we have an office at one end for the foreman, with a bunk, desk, and stove in there, and a bedroom for the men sufficient to accommodate twelve to eighteen men; also a sitting room in the other end, with a stove, chairs, table, lamps, etc., and in that way our men are always in the cars ready to move at a minute's notice.

Mr. Markley.—What advantage do you find in maintaining those cars?

Mr. Reid.—The main advantage is, we can get better men, and can hold them better, as they can live cheaper, where we have cars for them to live in; and it also saves running around over the road hunting boarding-places. In some places they cannot obtain board, and if they did it would take one or two men to hunt boarding-places, and then if we want to get them in a hurry to go to a washout or wreck we would have a regular skirmish drill to get the tools and men together. With the cars the tools are all in their places and every man knows where to find them, and in case of emergency we can couple an engine on and start off in a very short time, and when we get to the work every man has the tool that he is going to use, ready to go to work. Also, when going any great distance, they can sleep, and then they are ready to work better and longer after they get there.

COMMITTEE REPORTS FOR 1901-1902.

PRESENTED AT THE

TWELFTH ANNUAL CONVENTION, MINNEAPOLIS, MINN., OCTOBER, 1902.

I.—Auxiliary Coaling Stations: Best Designs, Capacity and Method of Handling Coal.

REPORT OF COMMITTEE.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your Committee No. 1, on the subject of Auxiliary Coaling Stations, after laboring two years and finding that the subject is good for at least ten years more, have decided to make a formal report, leaving the work of continuing the investigation to future generations of members, who will undoubtedly be able to tell us all how much we did not know about this all important matter of coaling locomotives.

Many years ago, when General W. S. Hancock was a candidate for president of the United States, he stated, during the campaign, that the tariff was a local issue. This declaration was vigorously debated by all parties at the time, each claiming that their peculiar ideas were the only correct ones. Your committee, at the close of their labors, have arrived at the conclusion that the best type of Auxiliary Coaling Station is a local issue also, and are prepared to prove it, should any member ever question the veracity of the statement.

Your committee began their labors of investigation on the subject of Auxiliary Coaling Stations by sending to the chief engineers of sixty-three of the important railroads of our country a letter, of which the following is a copy:

"Duluth, Minn., March 24, 1902.

"Dear Sir:—The committee appointed by the Association of Railway Superintendents of Bridges and Buildings to report on the subject of Auxiliary Coaling Stations, respectfully request the following information from your company to assist them in preparing a full report on this subject. The results will be carefully compiled and published in our next proceedings in October, 1902.

"1. Blue print plan of a typical auxiliary coaling station in use on your railroad.

"2. Approximate cost of construction of same.

"3. Capacity of pockets in net tons.

"4. (If consistent.) Cost of coaling locomotives at such station.

"5. Suggestions, based on your experience, for improvements you would recommend in building a new plant.

"It is the intention of the committee to prepare a practical report on the above subject, and your assistance is particularly

requested to enable us to accomplish the result desired. An early reply will be greatly appreciated.

"Yours very truly,

"W. A. McGONAGLE,

"*Chairman.*"

Replies were received from thirty-five of these railroads, and in nearly every case they expressed a strong desire to assist your committee in every way possible. Our questions were answered cheerfully and full plans sent wherever it was consistent to do so. Many of the railroads expressed their desire to know the results of the labors of your committee, and we hereby recommend that a copy of our proceedings be mailed to each chief engineer who replied to our circular letter, as a mark of the appreciation of our Association of the efforts of such officer to assist the Association in compiling complete data on this important subject.

One chief engineer asked us to define the term "Auxiliary Coaling Station," and we replied that it was an intermediate station as distinguished from the terminal station.

Your committee attributes the silence of the remaining twenty-eight railroad companies to several causes, as follows:

1. Some of them are ignorant of the importance of the Association of Railway Superintendents of Bridges and Buildings.

2. A few of them know it all, and don't feel like telling others.

3. Quite a number are ashamed of their coaling stations and don't like to admit publicly that they have the same system used by Noah for taking fuel into the ark.

4. A very few, some of them members of our Association, are squaring accounts with members of our committee for our silence in answering similar letters in past years.

To all of them your committee now say that we accept their apology, and hope they will learn something from the perusal of our report.

The type of auxiliary coaling station to be recommended for any particular point will be governed largely by the following conditions:

1. The quantity of coal to be handled in a given time.

2. The number of engines to be coaled in a given time.

3. If coal is to be stocked in large quantities for winter use or not.

4. If coal is delivered to station in bottom or side dump cars or not.

5. The personal equation of the general manager.

6. The topographical features of the surrounding country.

7. If the supply of coal is regular or irregular.

8. If the supply of coal is to be protected from the weather.

Before going farther it would be well to enumerate the several systems now in use in this country.

1. The system of shoveling from railroad cars to tenders, known as the *Armstrong* system.

2. Shoveling from cars to high platform to be shoveled again to tenders.

3. Crane and bucket system from storage platform.

4. Shoveling from cars into bins from elevated trestle.

5. Dumping coal from railroad car directly into bins.

6. Hauling railroad cars by cable up steep incline and dumping directly into bins.

7. Dumping coal from railroad cars into pit and elevating it by conveyors.

8. Dumping coal from railroad cars into pit and elevating it by air hoist.

9. Locomotive crane working from stockpile to bins or to engines.

10. Dumping through trestle to platform and tramming and dumping into tenders.

11. Dumping into pit in track and elevating skip by switch rope by engine taking coal.

1. The system of shoveling from railroad cars directly into locomotive tender is usually employed where work trains or pushers are in service. It is expensive and should not be used except where there is only a very small consumption of fuel. The cost of operating this system, as usually employed, will approximate twenty-five cents per ton.

2. This system is frequently employed at points where two or three car-loads of coal per day are used. Like No. 1, it is a makeshift and should not be used except where conditions of poverty compel its use. The cost of operating this system varies from twenty-five to fifty cents per ton, depending upon conditions of labor and climate.

3. This system is in use on numerous roads in the United States. The coal is dumped from railroad cars from an elevated trestle to a storage platform on the ground. It is then shoveled into buckets and pushed on tram cars to the crane, where it is hoisted and dumped into the engine tender. The system is antiquated and very expensive, and several reports show as high a cost as thirty-five cents per ton, the cost depending on labor conditions and the distance the coal is trammed

4. This is well known as the Williams-White system. Nu-

merous variations have been made in order to avoid the royalty asked by the inventors, but the results pretty generally show that it would have been better to pay the royalty. The cost of coaling by this system varies from six to ten cents per ton, depending upon labor conditions. The system is generally satisfactory where a moderate amount of fuel is required and topographical conditions will permit the necessary inclined trestle to be constructed economically.

5. This is the ideal system of coaling locomotives. The coal is taken in bottom or side dump cars and dumped by trainmen directly into bins, thus elimenating all the extra labor required by the other systems and saving very largely the delay to cars. Its use is limited by topographical conditions in constructing the inclined trestle approach. The cost of coaling by this system varies from one and one half to three cents per ton.

6. This system is ideal, where the previous system will not apply, on account of topographical conditions. The objection to it is the fixed charge for labor and supplies for hoisting engine and the expensive maintenance of cables and pulleys, but notwithstanding these charges the stations are operated at the very low cost of three cents per ton.

7. This system is very satisfactory when it can be operated in connection with a pumping station, in order to divide the cost of operation. There is considerable expense and frequent annoying delays with conveyors of any type, but notwithstanding this, the cost of operation has been reported as low as three cents per ton. One great advantage of this system is that it can be constructed in localities where No. 5 and No. 6 are out of the question, on account of the ground occupied by the inclined trestle approach. This system is very compact and is admirably adapted for all points where yard room is limited and where there is suitable drainage for the dumping pit.

8. This system is in use in several places where a limited amount of coal is required to help engines over the road. The coal is dumped into a pit under the main track and thence by gravity into buckets. These buckets are hoisted by an air hoist operated by the compressed air from the train line of the locomotive taking coal. The cost is five to ten cents per ton, but the system cannot be recommended except as stated above.

9. This system is in use on at least two important lines, and seems to give entire satisfaction. It is particularly to be recommended where large storage is required. The coal is stored by being dumped from a high trestle to a platform on the ground. A locomotive crane is then run on the same high trestle and the coal is picked up with a clam shell and dumped into movable pockets for engine use or into gondola cars for immediate shipment. The movable chutes are a novel feature and are moved from place to place along the coal pile as the coal is removed by

the locomotive crane. The cost of coaling by this system is one and three quarter cents per ton.

10. This system is in use in several places where large storage is required. It is expensive, as are all systems where the coal has to be shoveled. It is not to be compared with No. 9 in economy of operation, but of course is much cheaper in construction. The cost of coaling by this system is from ten to fifteen cents per ton.

11. This system is in use on several roads, but is not very satisfactory, owing to the danger of personal injury by broken ropes and sheaves. The cost appears to be low, but the real cost when accidents are considered is prohibitive. The apparent cost of coaling by this system is from five to ten cents per ton.

A large number of blue prints have been received from the different railroads answering our circular letter. We have carefully selected such parts of them as would clearly indicate the different types of stations. These illustrations will be found in the appendix to this report.

CONCLUSION.

Your committee, after due consideration of all the information sent them, have drawn the following conclusions:

1. The best type of auxiliary station is that by which the coal for locomotive supply is dumped from bottom or side dump railroad cars directly into the bins, the cars being pushed up an inclined trestle by a locomotive, dumped by the trainmen, and the empty car taken away immediately thereafter. This is designated as No. 5 in our report, and the cost of coaling locomotives can be reduced to one and one half cents per ton, and all fixed charges for operation avoided.

2. Where topographical conditions prevent the construction of the long inclined approach, we recommend the system of hauling the railroad car by gasoline engine hoist up a trestle approach of twenty per cent. grade and dumping the coal directly into the bins. This is designated as No. 6 in our report, and the cost of coaling locomotives is three cents per ton.

3. Where topographical conditions further prevent the construction of the steep incline, or where the crowded yard conditions prevent the adoption of the previous systems, we recommend the type of pockets known as the McHenry system, where the coal is dumped from cars into a pit under the track and elevated to bins by a conveyor system. This is designated in our report as No. 7, and can be operated at a cost of three cents per ton.

4. Where it is necessary to coal engines from several tracks

we recommend the conveyor system in use by the New York Central and Hudson River Railroad. The experience of this very important railroad has demonstrated the success of this type of coaling station. The cost of operating by this system is three to six cents per ton, depending upon the amount of coal used.

5. Where large storage capacity is required we recommend the system employed by the Southern Pacific Railway and the Louisville & Nashville Railway, where the coal is dumped from a high trestle into bins for immediate use, or to a platform for storage, and is picked up from storage by a locomotive crane with clam-shell dipper and dumped into bins or directly into locomotive tenders, as desired. The movable chutes are especially commended as ingenious and effective. The cost of coaling by this system is one and three quarter cents per ton.

6. Where it is necessary to shovel coal once, or where coal must be received in gondola or box cars, your committee recommend the Williams-White chutes as being the best possible under the given conditions. The cost of coaling by this system varies from six to ten cents per ton. This is designated as No. 4 in our report.

This is as far down the list as your committee care to make recommendation. The other systems have been indicated, and the personal equation of the general manager will often determine the question whether they will or will not be used. The question is a broad one and is capable of continued improvement as our transportation facilities become taxed heavier and heavier and time becomes the all-important item. Let us hope that our railroads will encourage the study of this question and thus hasten the time when the greatest amount of coal can be taken in the least period of time at the lowest cost per ton and with a minimum cost of plant. This is the goal to be reached, and if your committee have even indicated the pathway they will feel amply rewarded for their labors.

W. A. McGonagle,
Chairman,
G. W. Smith,
E. Fisher,
J. P. Snow,
B. F. Bond,
R. B. Tweedy,
Committee.

ADDITIONAL METHODS.

DESCRIBED BY J. P. SNOW, MEMBER OF THE COMMITTEE.

Two methods of coaling engines, somewhat different from those elsewhere described in this report, are in common use on Eastern roads, and are shown on the illustrations marked Boston & Maine Railroad. They are applicable where the number of engines to be coaled per day does not warrant the installation of expensive plants, and where there is ample time to take coal without delaying train movements.

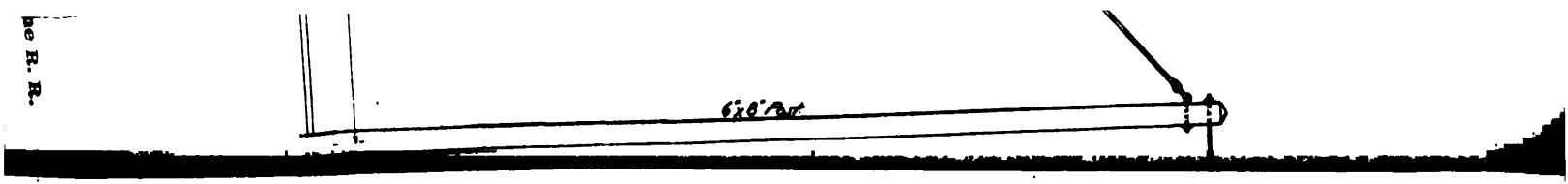
One may be described as a dump-car method and the other as a tub method. Both are usually supplied by an inclined trestle running to any height desirable, from 12 to 25 feet, and with the storage covered or open, as may be decided upon.

The dump-car method is shown by the shed at Worcester, Mass., and the turn-table, transfer table, and car that goes with it are also shown. It will be seen that the shed has three tracks in its floor, with cross tracks at two points served by turn-tables. These tracks lead out to a transfer table track, which sets the cars on to the tracks, on which they stand when dumped into the tenders. A scale is placed under the transfer track, so that all coal can be weighed if desired. The two delivery sheds are made necessary from the fact that both coal and coke are served from this outfit.

In operation a great deal of the coal is discharged from the overhead trestle through a rough hopper spout, not shown on the drawing, directly into the dump cars below. When no supply is available for loading the cars in this way the dumps are filled by shoveling from the store pile.

The cost of a shed of this sort above the foundations, and exclusive of the outside approach trestle, is approximately $2.00 per ton of storage capacity, and the cost of unloading and delivery to locomotives about 9½ cents per ton.

The tub method involves the use of a derrick. This, of course, may be operated by any power, even hand power, as shown on one drawing of the report. The power generally used, however, on the Boston & Maine Railroad, and that for which the derrick here shown is designed, is the locomotive itself. The fall is led through a sheave in the step block of the derrick and along the side of shed to a snatch block at a sufficient distance, so that when the line is made fast to the side of a tender, the engine in moving opposite the derrick will have raised a tub to the proper height for swinging over the tender, where it can be dumped. Ton and half ton tubs are used, the former being raised by a running block in the bight of the fall, and the latter by a single line.


he R. R.
6'8"

The favorite tubs are wooden ones, with truck wheels in their bottoms; they are dragged by the men from the pile to the derrick. The cost of the derrick, with rigging and ten half-ton tubs, is about $700, and the cost of operation 10 to 12 cents per ton, depending on the chance to keep the men at work regularly. Hopper spouts are used with this method for filling the tubs directly from the supply cars on the trestle, the same as described above for filling dump cars.

This method of coaling engines can be used, of course, only at small terminals, where there is plenty of time in which to take coal. At larger terminals an electric or gasoline hoist is used in place of the locomotive for raising the tubs, while for wayside points, where engines must take coal when attached to their trains, dump cars or chutes only are admissible.

J. P. Snow,
Bridge Engineer, B. & M. R. R.

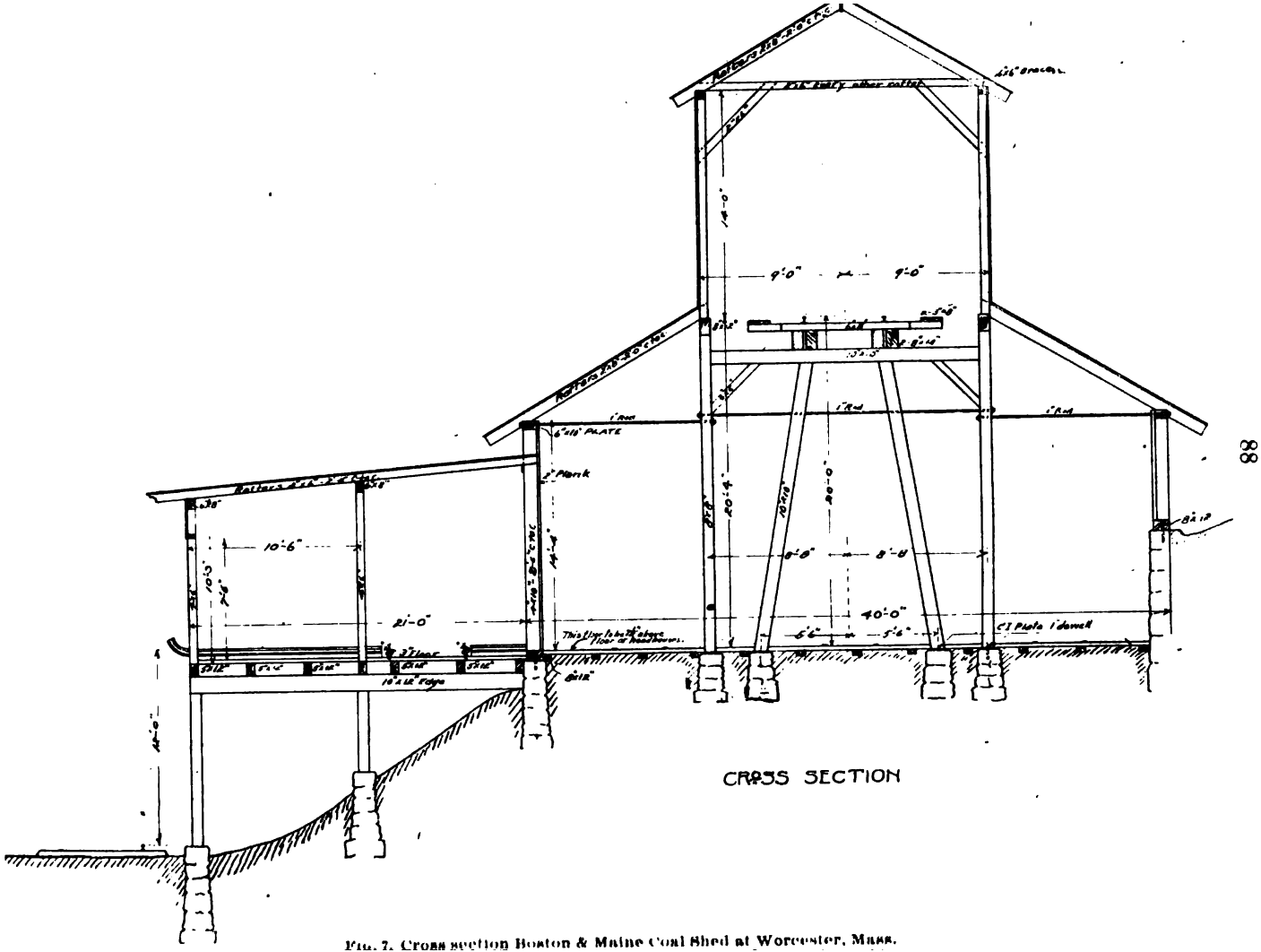


Fig. 7. Cross section Boston & Maine Coal Shed at Worcester, Mass.

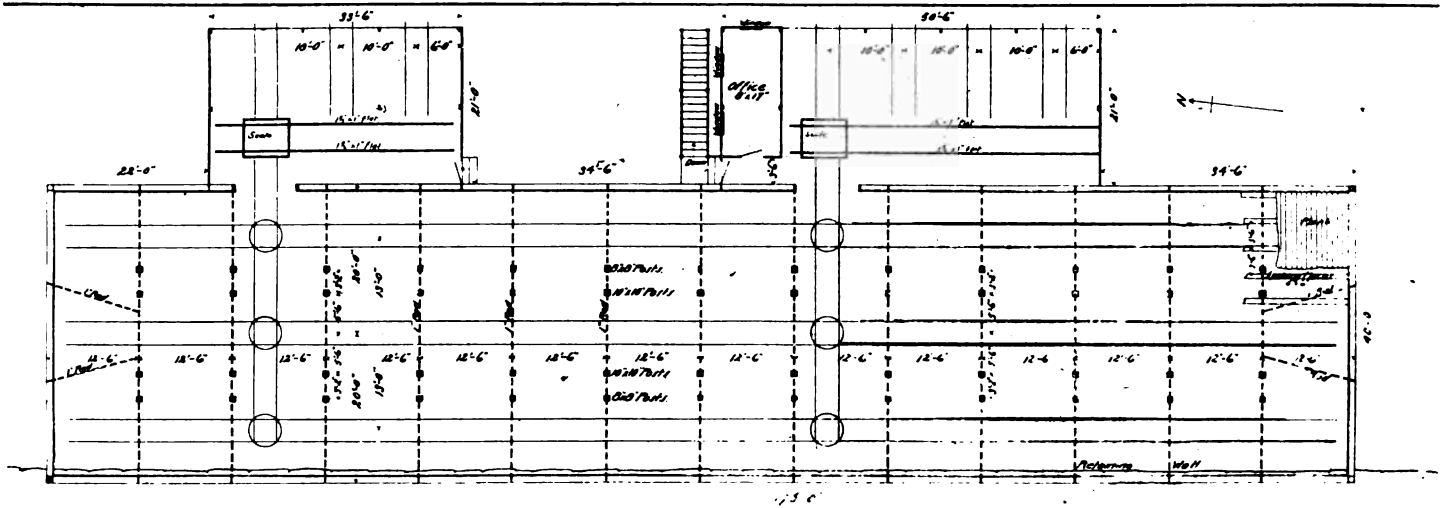


Fig. 8. Coal Shed Boston & Maine R. R.

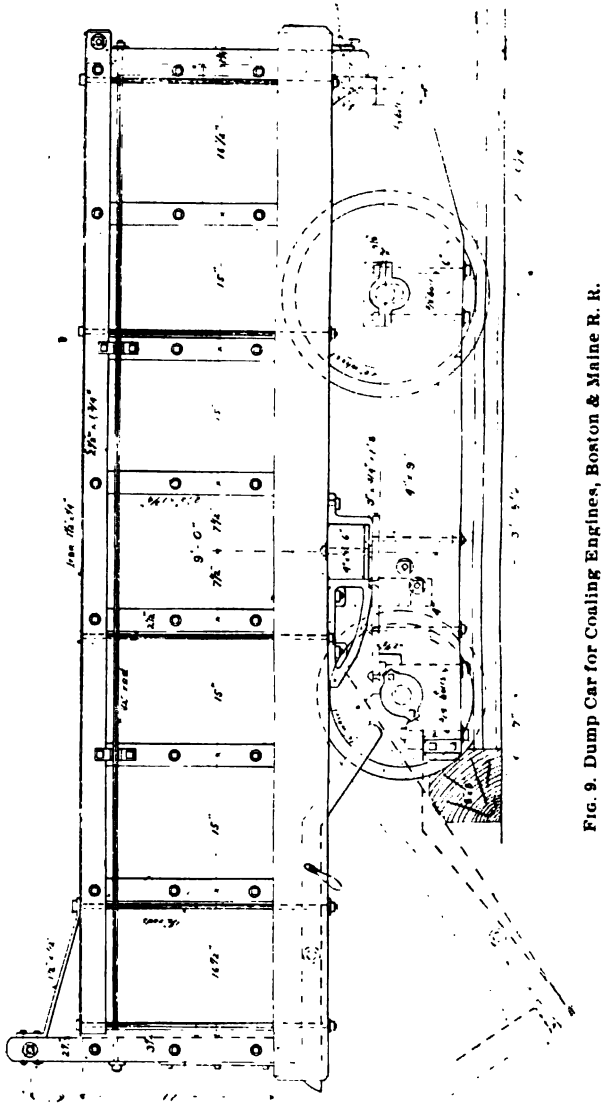


Fig. 9. Dump Car for Coaling Engines, Boston & Maine R. R.

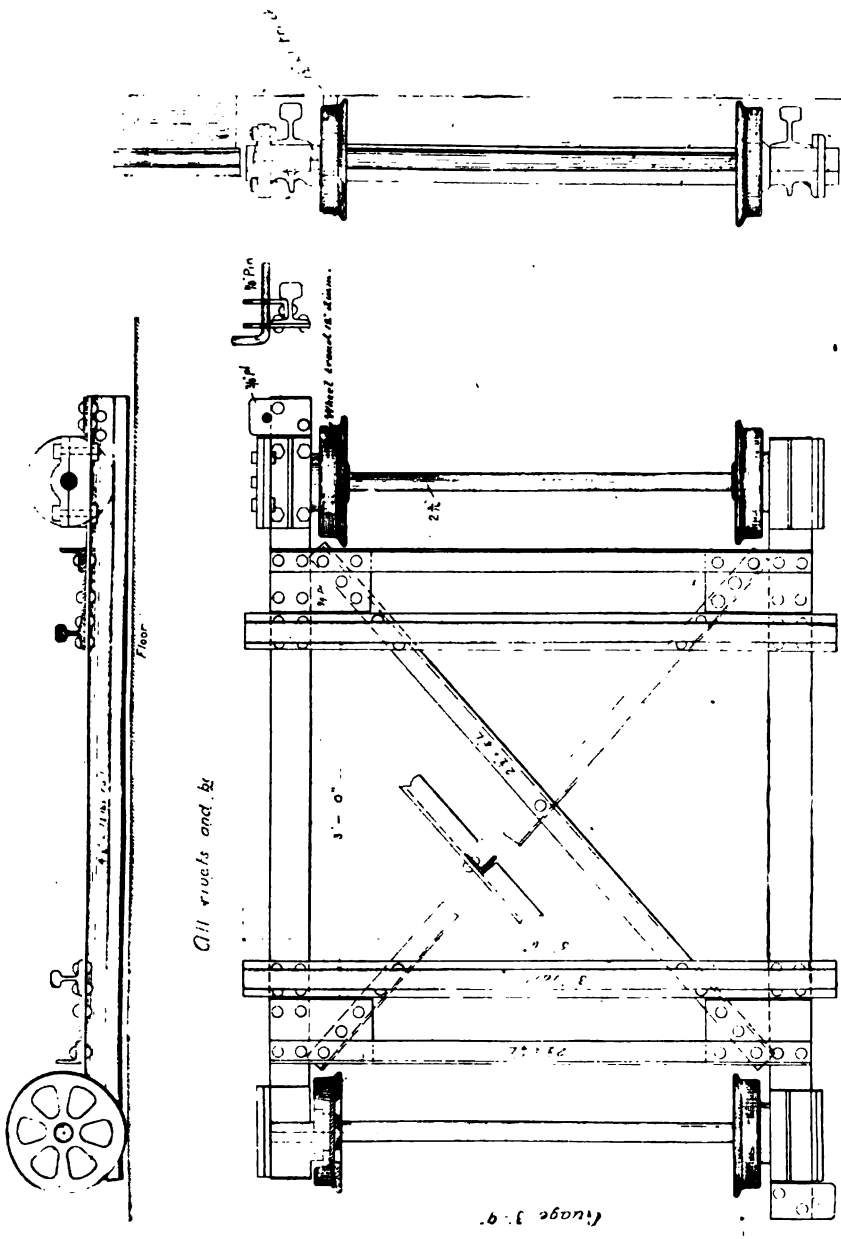


FIG. 10. Transfer Table for Coaling Dumps. Scale, 1½ inches to 1 foot. December, 1890. Boston & Maine R. R.

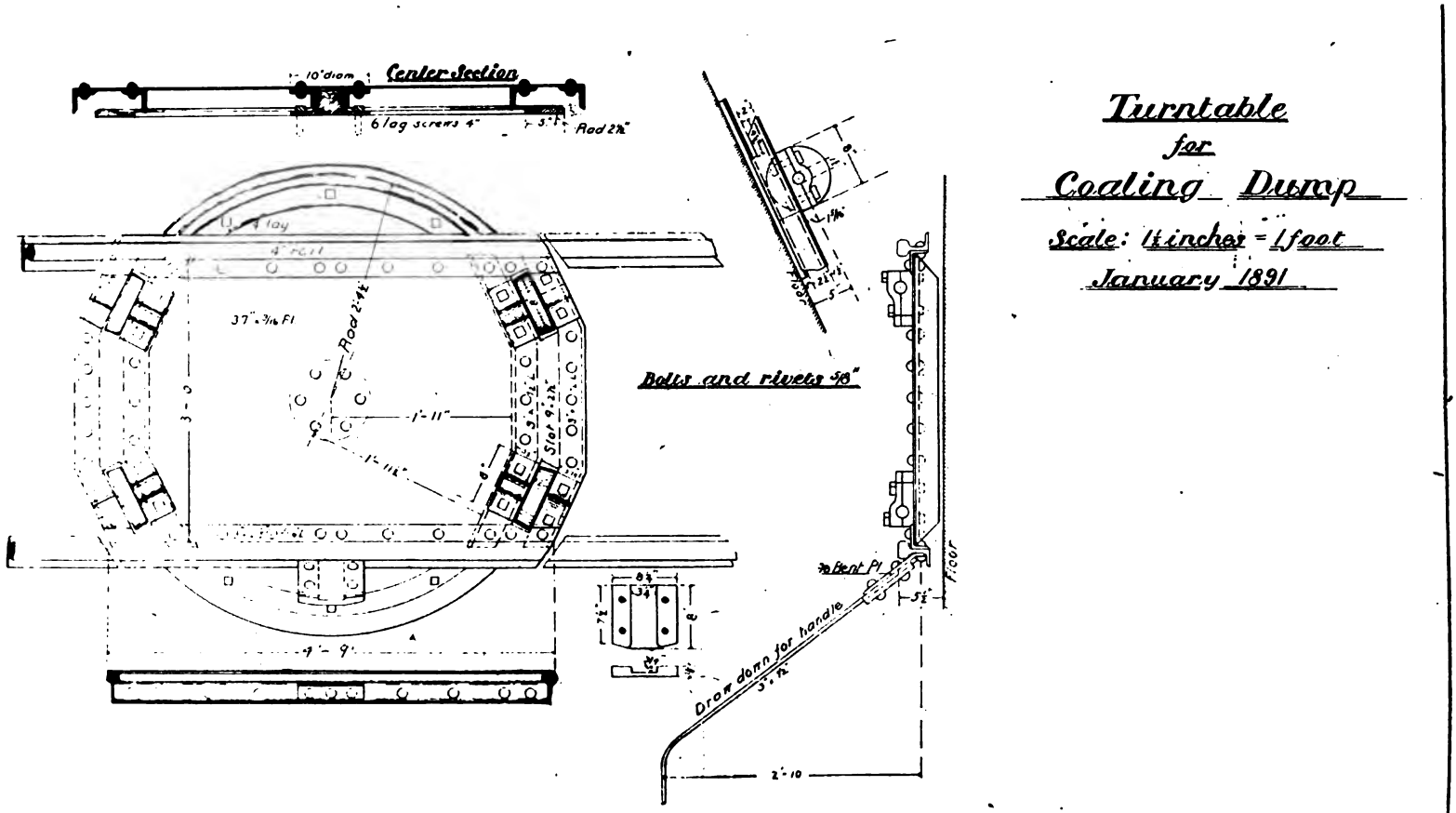


Fig. 11. Boston & Maine R. R.

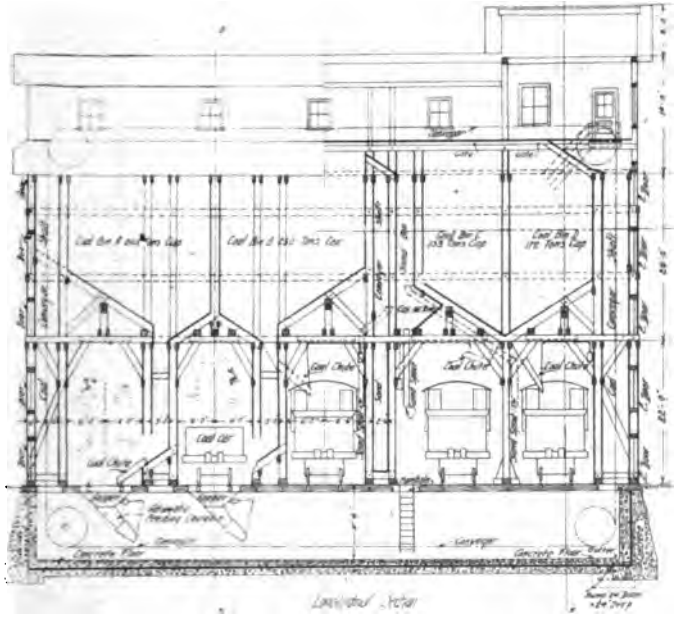


FIG. 12. Coal Pockets at Syracuse, N. Y., C. & H. R. R.

AUXILIARY COALING STATIONS.

NAME OF ROAD.	Type of station.	Cost of construction.	Tons capacity of pockets.	Cost of coaling per ton.	Remarks.
Seaboard Air Line	10	$4,500	825	9 cts.	
W. & L. E.	5	5,500	25	.....	No cost given. Is figuring on F. M. & Co. chutes.
N. & W.	5	6,000	.....	2½ to 3½ cts.	N. & W. is a coal road.
Tex. Midland	5	3,760	10	21 cts.	Not altogether satisfactory.
C., M. & St. P.	4	100 per pocket 1,600 per trestle	4½	7 cts.	Plans under revision.
C. R. R. of N. J.	....	.....	.....	5.9 cts.	No plans. Old systems.
B. & M.	4	.....	.....	.....	
B. & M.	10	.....	.....	.....	
B. & M.	11	.....	.....	.....	
Southern Ry.	7	.....	.....	.....	
Phila. & Reading	5	22,960	35	5 cts.	
Union Pacific	7	.....	.....	.....	Not in use long enough to ascertain cost per ton.
Great Northern	6	6,500	6	3 cts.	20 pockets.
A., T. & S. Fe	6	8,000	5	3 to 7 cts.	
L. S. & M. S.	....	.....	.....	1½ to 4 cts.	
D. & I. R. R. R.	7	4,000	50	3 cts.	Some trouble spilling coal from conveyor.
D., S. S. & A.	3	.....	.....	15 cts.	Crane and bucket system; trestle, $9.60 per foot; derrick, $75.
P. & L. E.	7	15,000	200	.....	Not yet in operation.

L. & N.	0	$38,000	3, 4, 5, and 7	3 cts. per bu.	Entirely satisfactory.
B., C. R. & N.	4	2,550		10 cts.	
So. Pac. Co.	9	9,000	8	1¼ cts.	One man handles crane and fills chutes.
N. Y. C. & H. R. R.	8	5,500		10 cts.	Air hoist from storage platform.
N. Y. C. & H. R. R.	5			5 cts.	
N. Y. C. & H. R. R.	7	9,000	160	3 to 6 cts.	
N. Y. C. & H. R. R.	7	15,000	450	3 to 6 cts.	
N. Y. C. & H. R. R.	7	9,500	160	3 to 6 cts.	
N. Y. C. & H. R. R.	7	19,000	300	3 to 6 cts.	
N. Y. C. & H. R. R.	7	22,000	850	3 to 6 cts.	
N. Y. C. & H. R. R.	7	24,300	850	3 to 6 cts.	
N. Y. C. & H. R. R.	7	18,000	420	3 to 6 cts.	
St. L. & S. F.	4			7.38 cts.	43,007 tons handled in one month.
Wabash	4	7,170		Aver. 6.1 cts.	
D. M. & N.	5	3,500		1½ to 3 cts.	Entirely satisfactory.
Penna. R. R.	5	6,200	230	2½ to 3 cts.	
Penna. R. R.	5	6,600	253	2½ to 3 cts.	
Mex. Cent. R. R.	4	4,200	5	6½ cts.	
C., R. I. & P.	4	1,600	6	6 to 7½ cts.	Entirely satisfactory. $4.50 per lin. ft. trestle approach.
M. & St. L.	4	150 per pocket		7½ to 8½ cts.	$4.50 per lin. ft. trestle approach.
C. & E. I. R. R.	4	4,400		5½ to 6½ cts.	
Pere Marquette	7	7,600	2 at 40 tons		Not in use long enough to give cost per ton.
Pere Marquette	7	3,600	4 at 40 tons		
M. C. R. R.	7	18,000	3 to 7 tons	3½ to 5 cts.	40 pockets.
Plant System					Use platform bins.

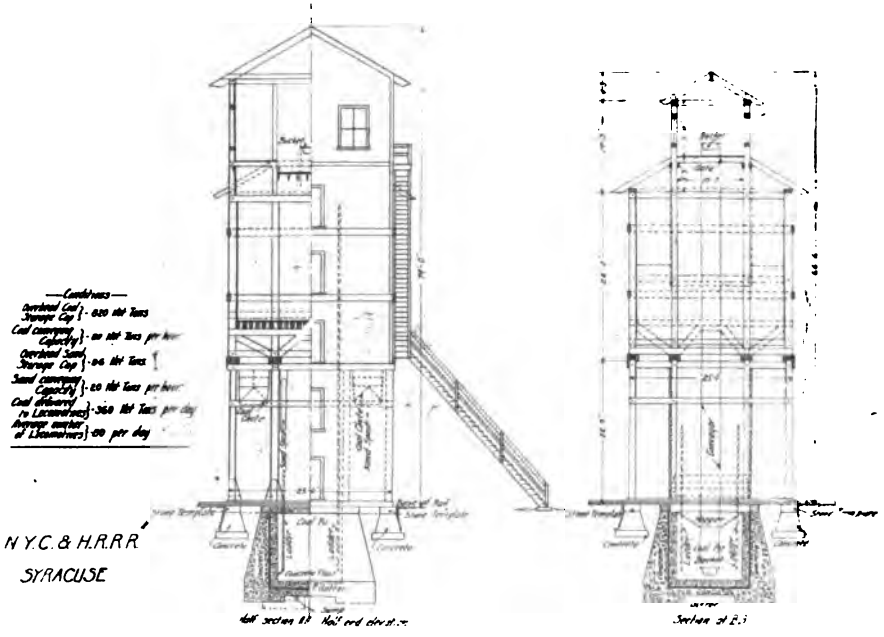


FIG. 13. Coal Pockets at Syracuse, N. Y. C. & H. R. R. R.

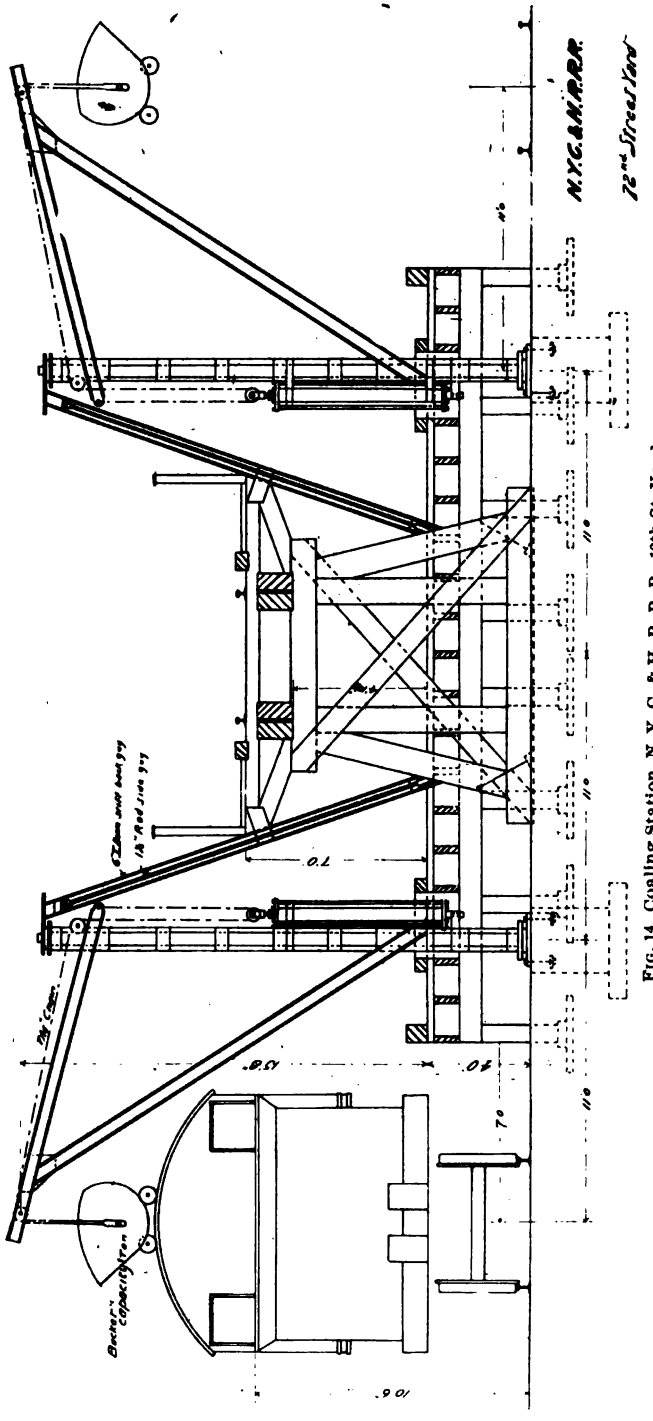


FIG. 14. Coaling Station, N. Y. C. & H. R. R. R., 12th St. Yard.

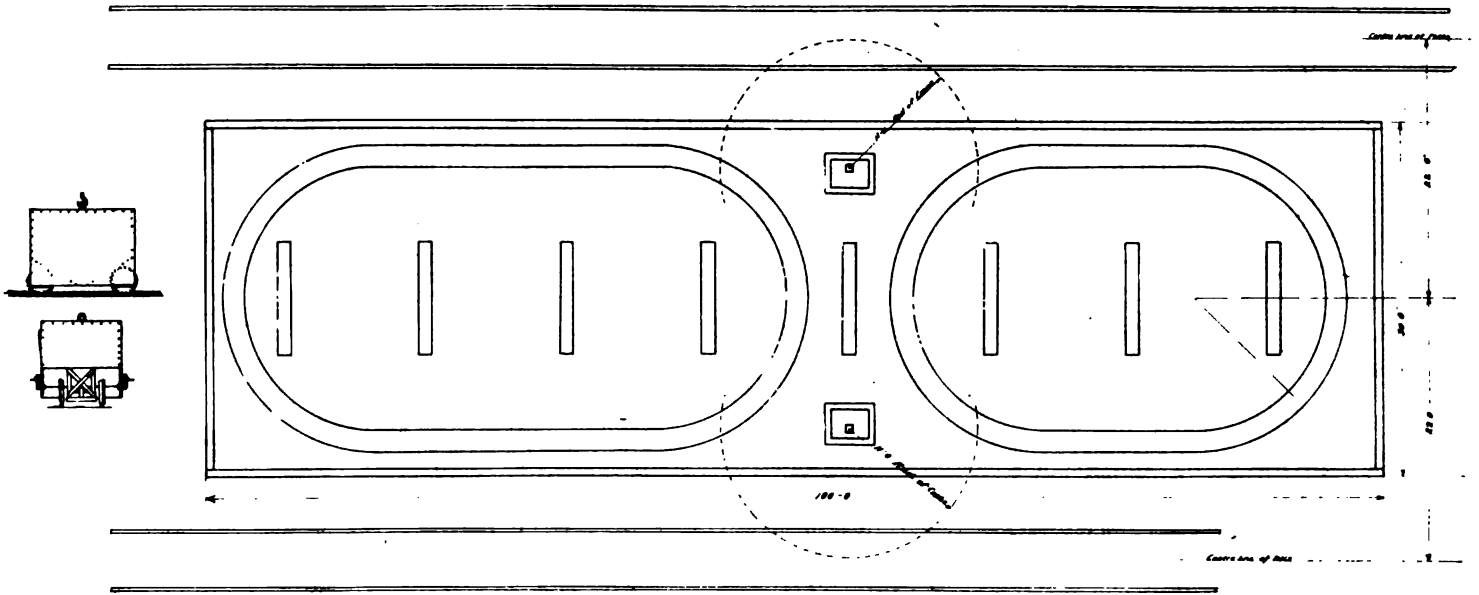


Fig. 15. Coaling Station at New York, N. Y. C. & H. R. R. R.

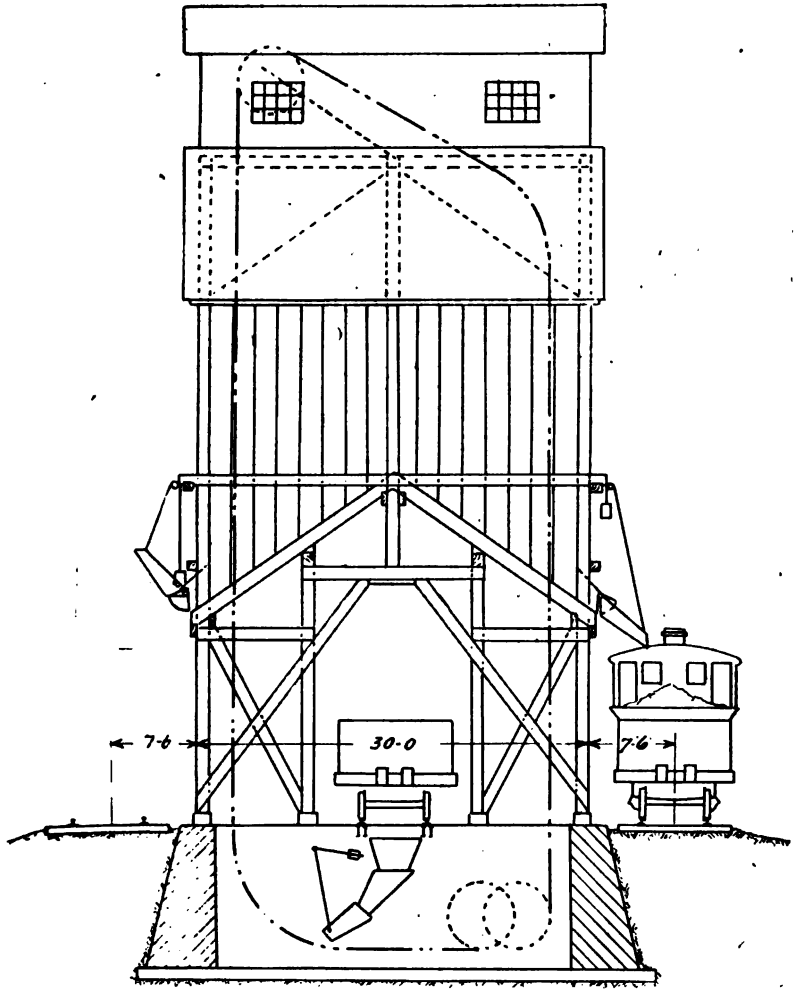


FIG. 16. Coal Pockets at Kingston, N. Y. C. & H. R. R. R.

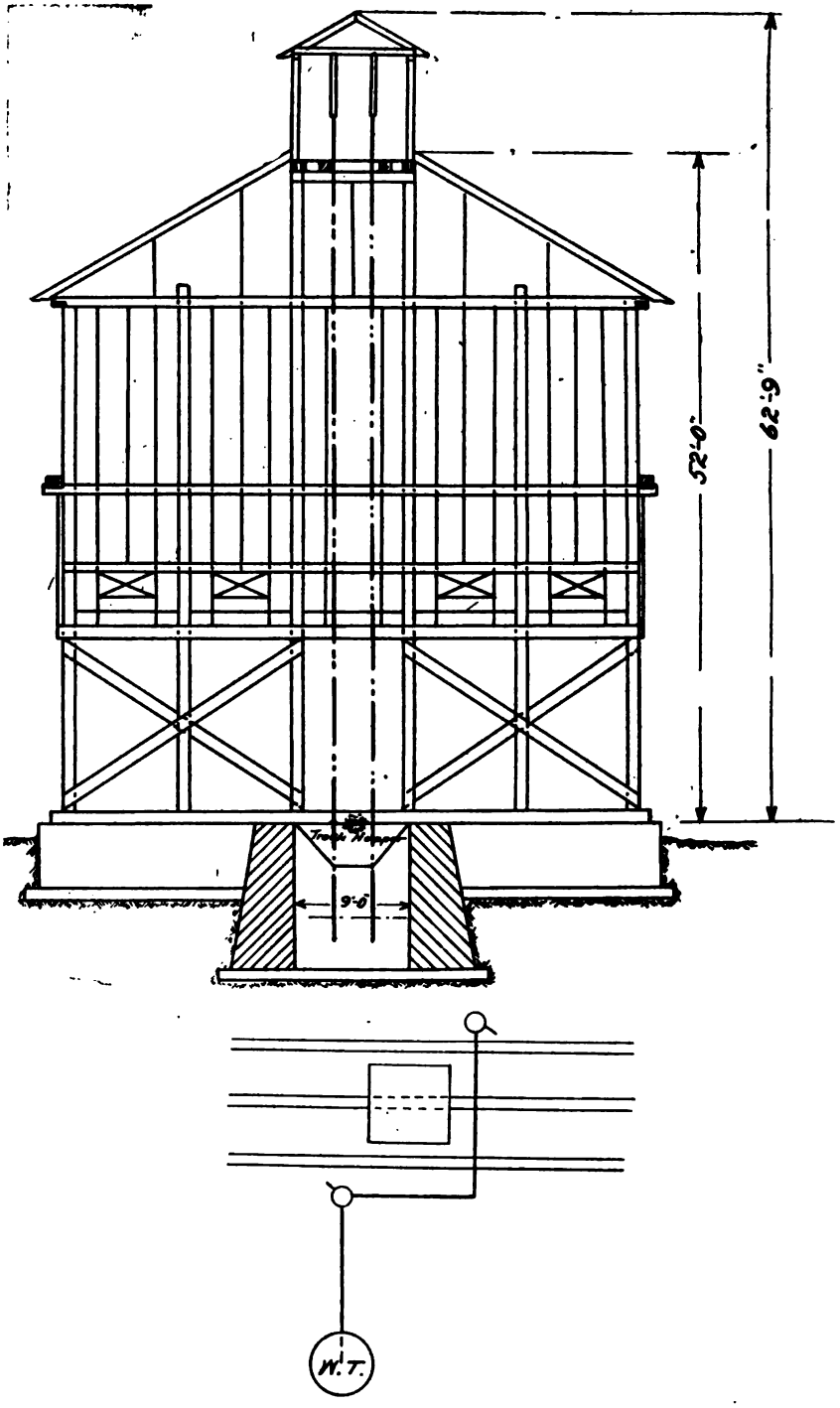


Fig. 17. Coal Pockets at Kingston, N. Y. C. & H. R. R. R.

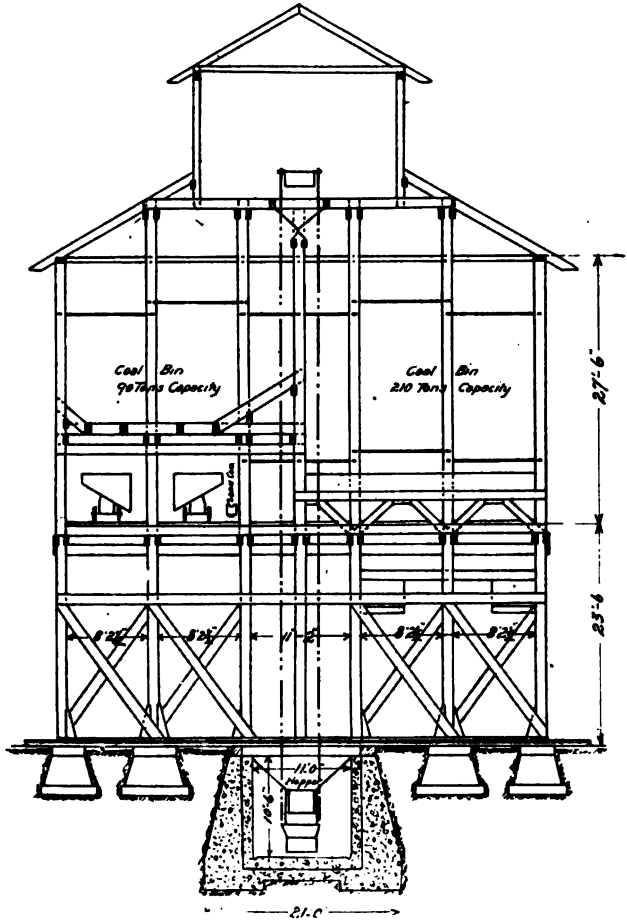


FIG. 18. Coal Pockets & Sand Bins, N. White Plains, N. Y. C. & H. R. R. R.

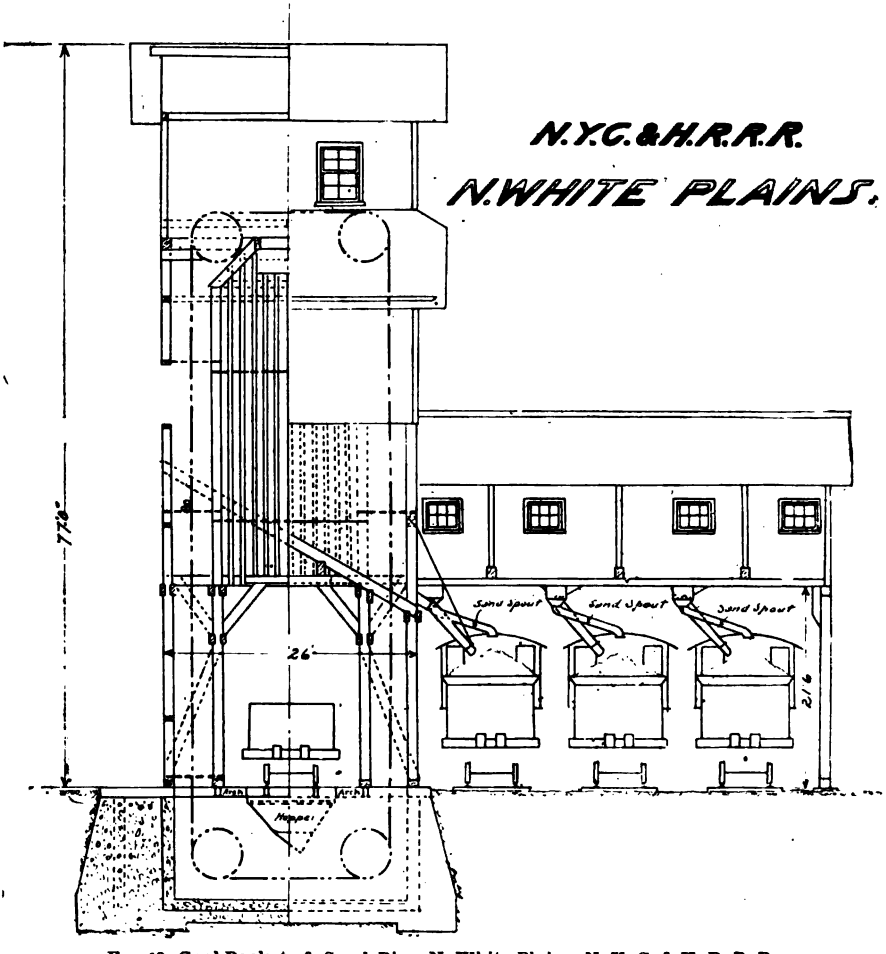


FIG. 19. Coal Pockets & Sand Bins, N. White Plains, N. Y. C. & H. R. R. R.

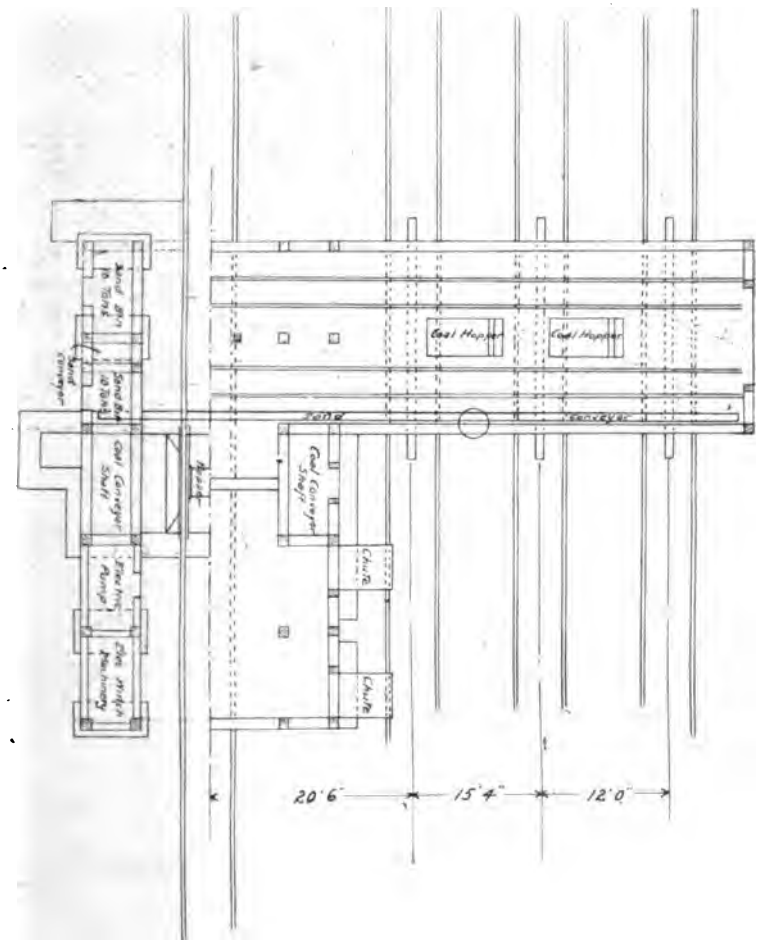


Fig. 20. Coal Pockets & Sand Bins, N. White Plains, N. Y. C. & H. R. R. R.

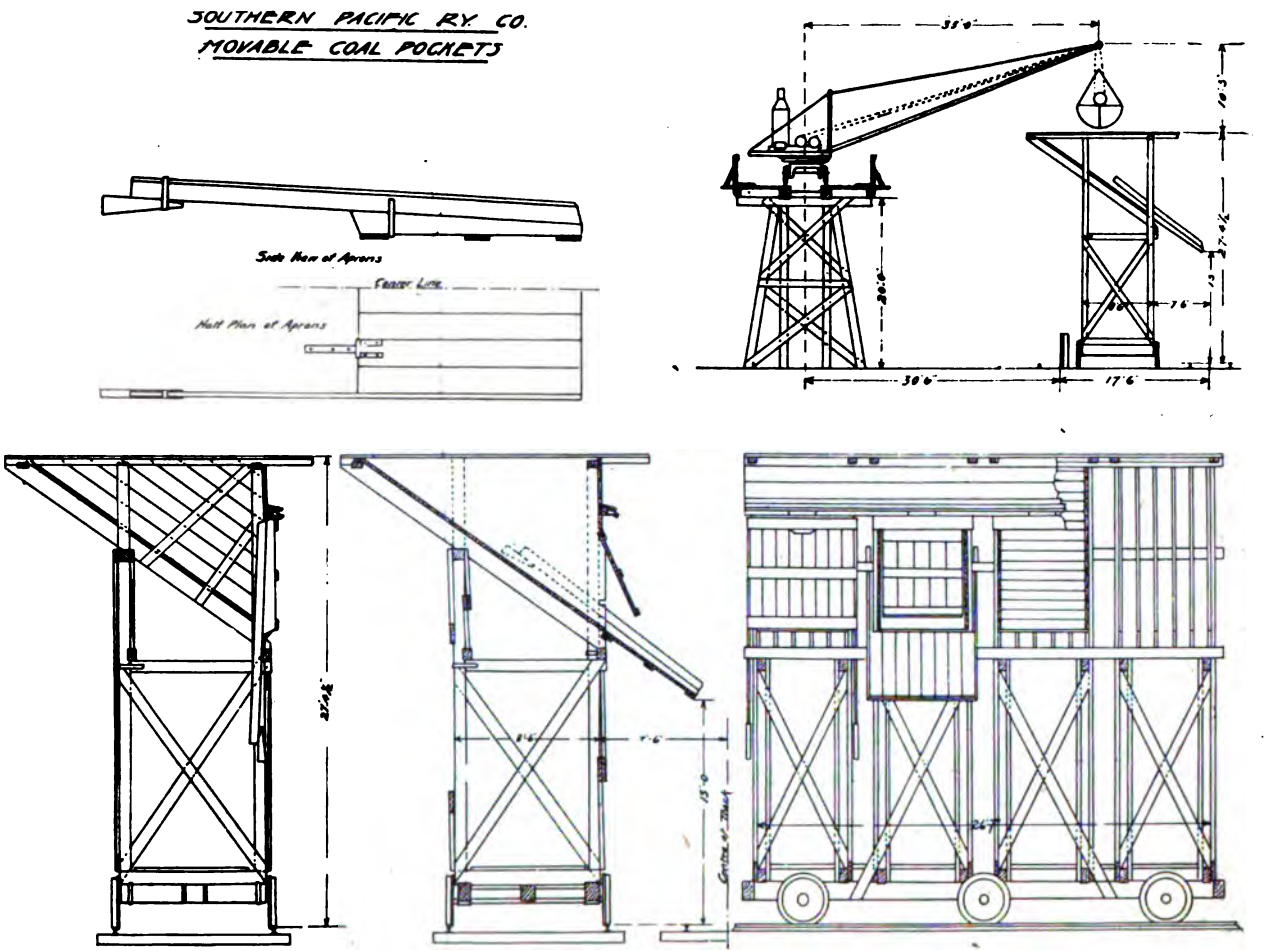


Fig. 21. Movable Coal Pockets, Southern Pacific Ry.

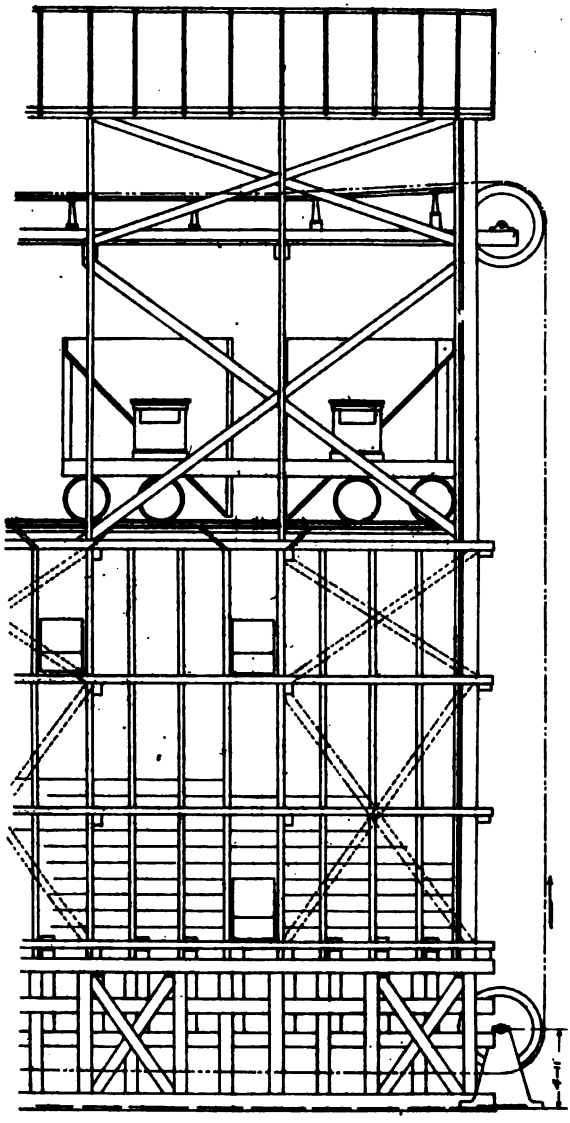


Fig. 22. Coal Pockets, Southern Ry., Mobile, Alabama.

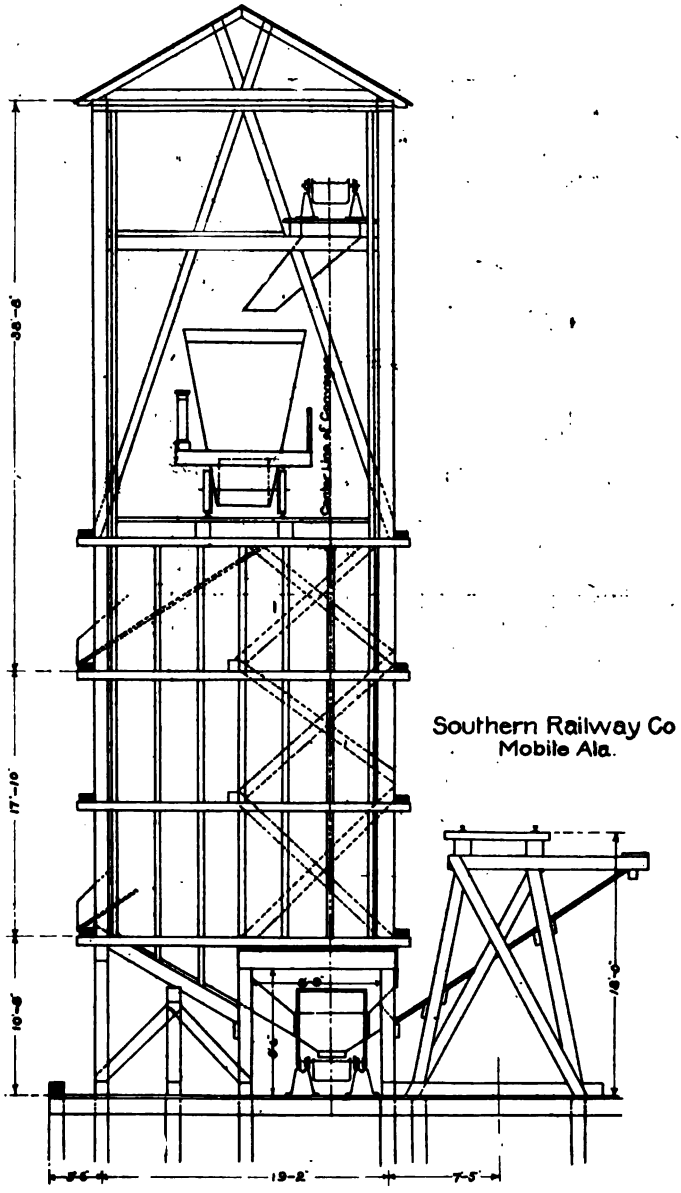


FIG. 23. Coal Pockets, Southern Ry., Mobile, Alabama.

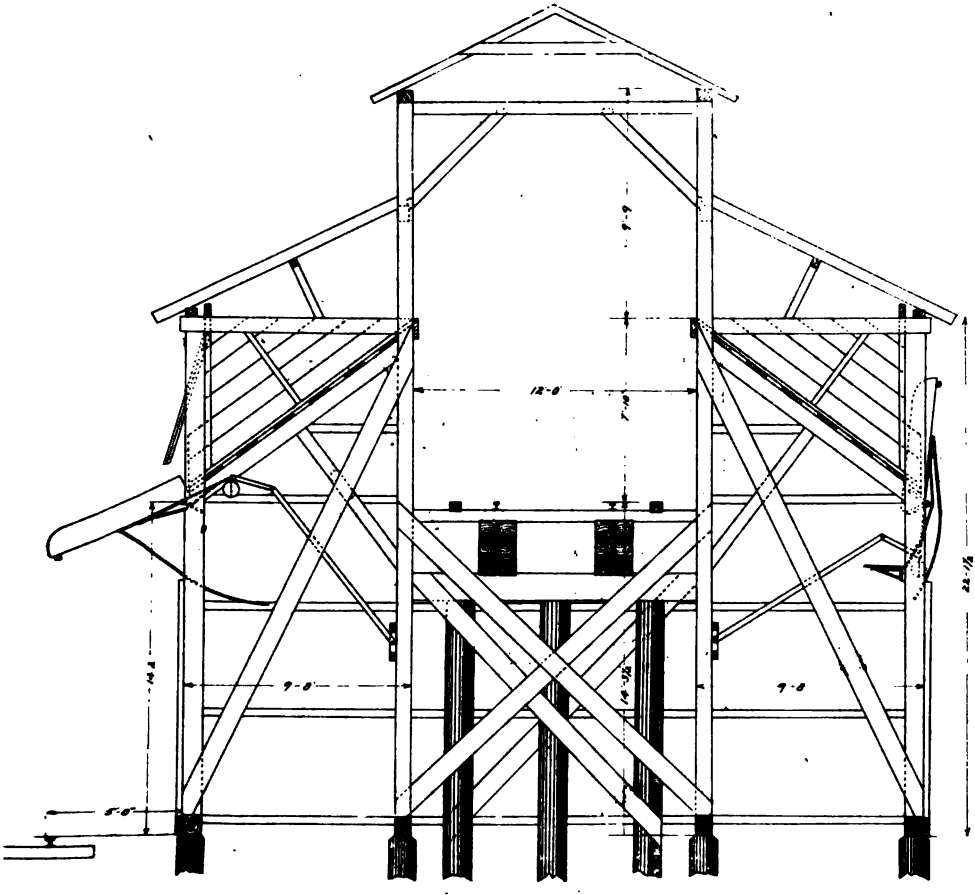


FIG. 24. Coal Pockets, Chicago & Eastern Ill. R. R.

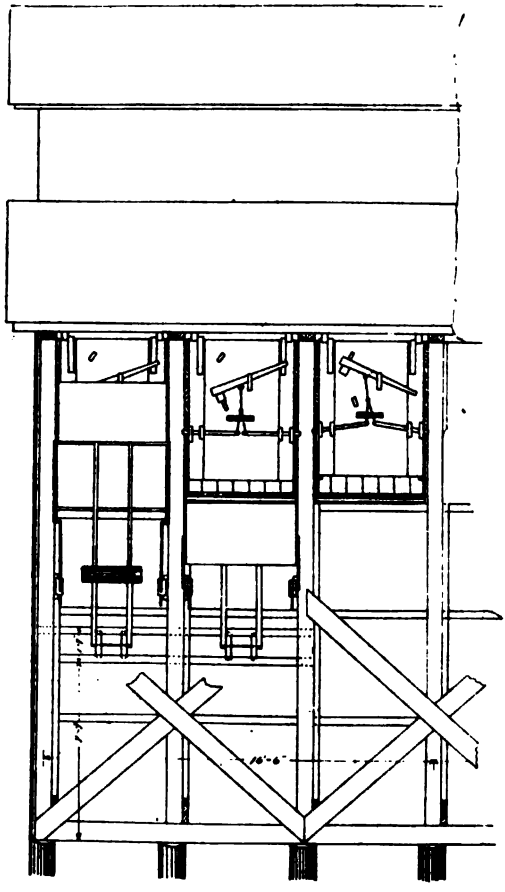


FIG. 25. Coal Pockets, Chicago & Eastern Ill. R. R.

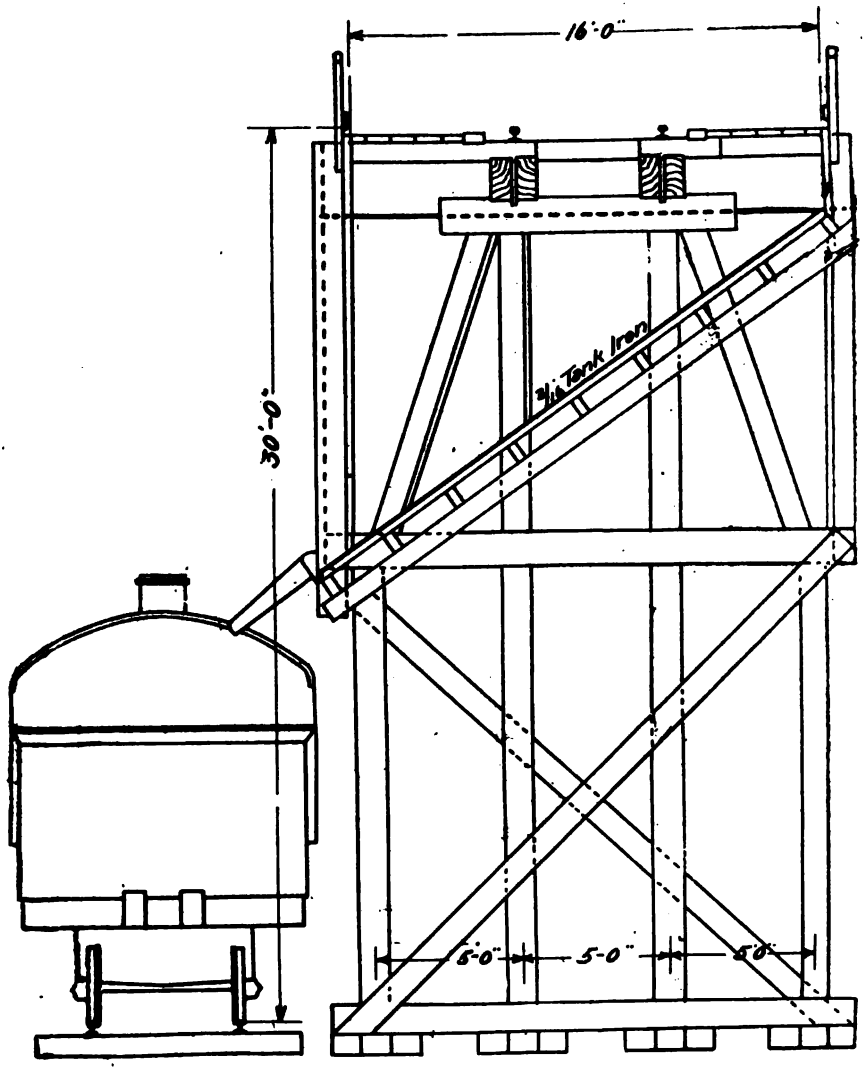


FIG. 26. Pennsylvania R. R. Coaling Station.

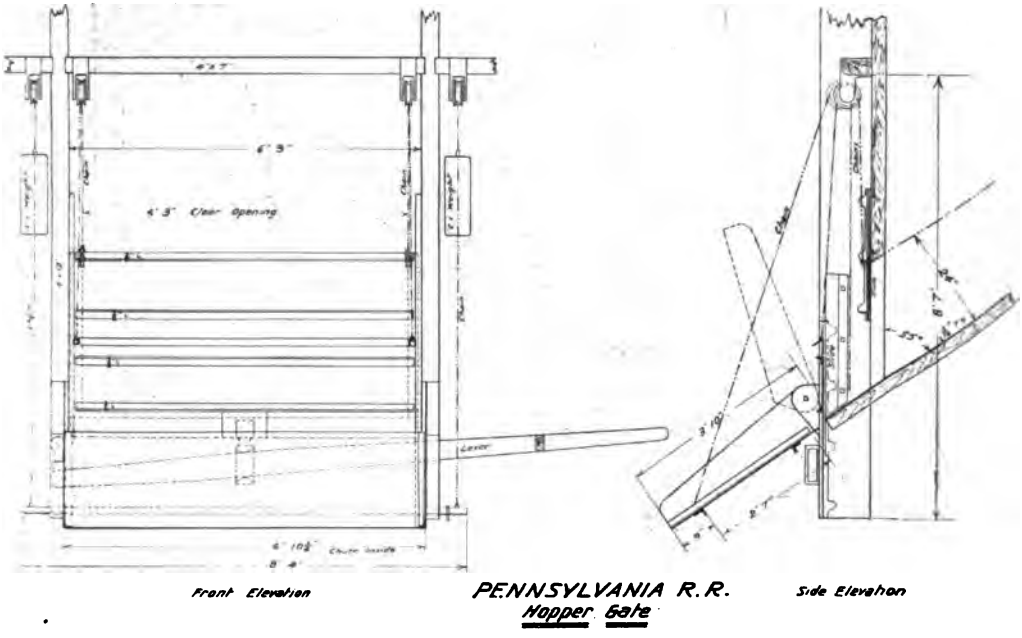


FIG. 27. Penna. R. R. Hopper Gate.

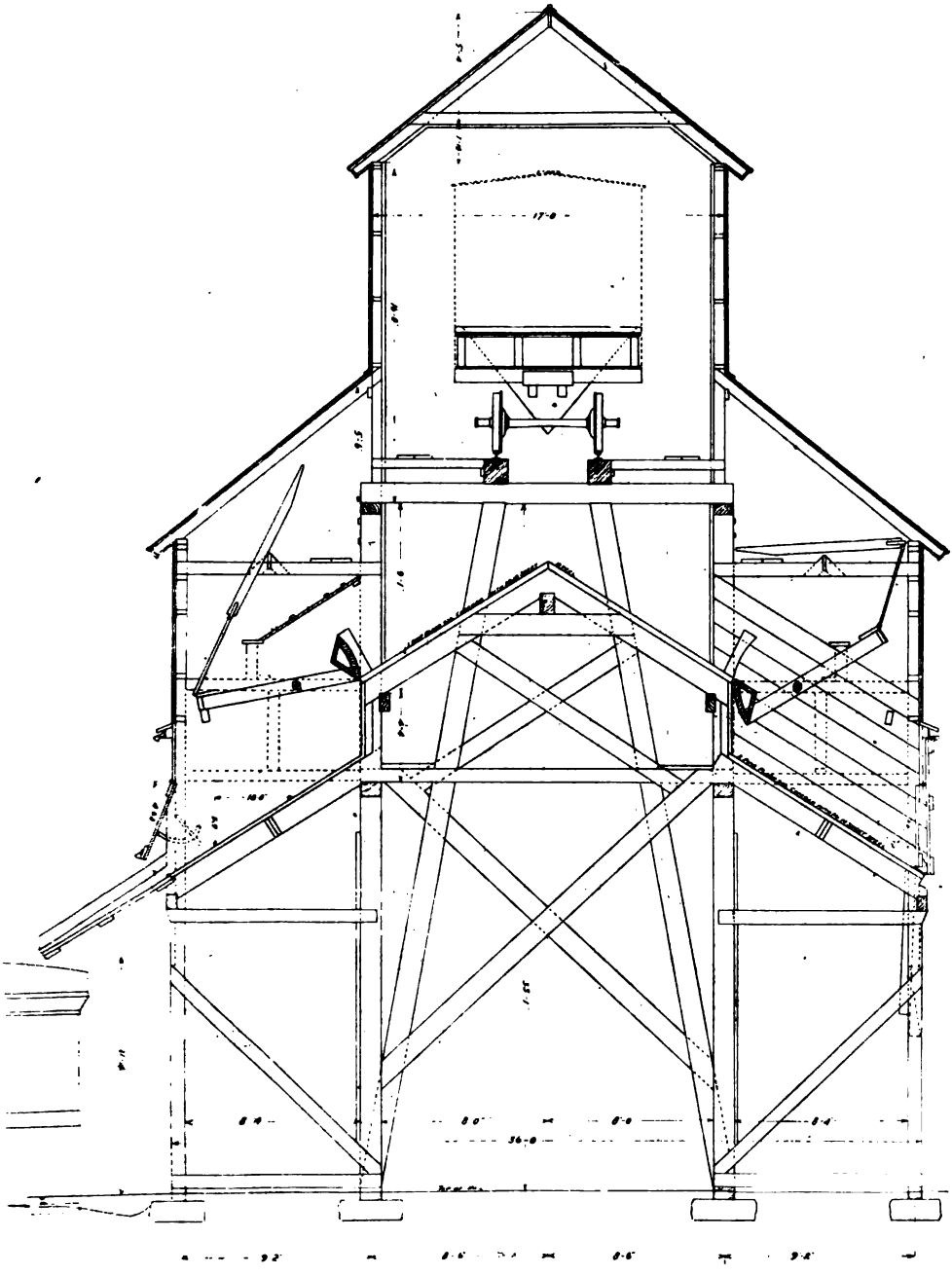
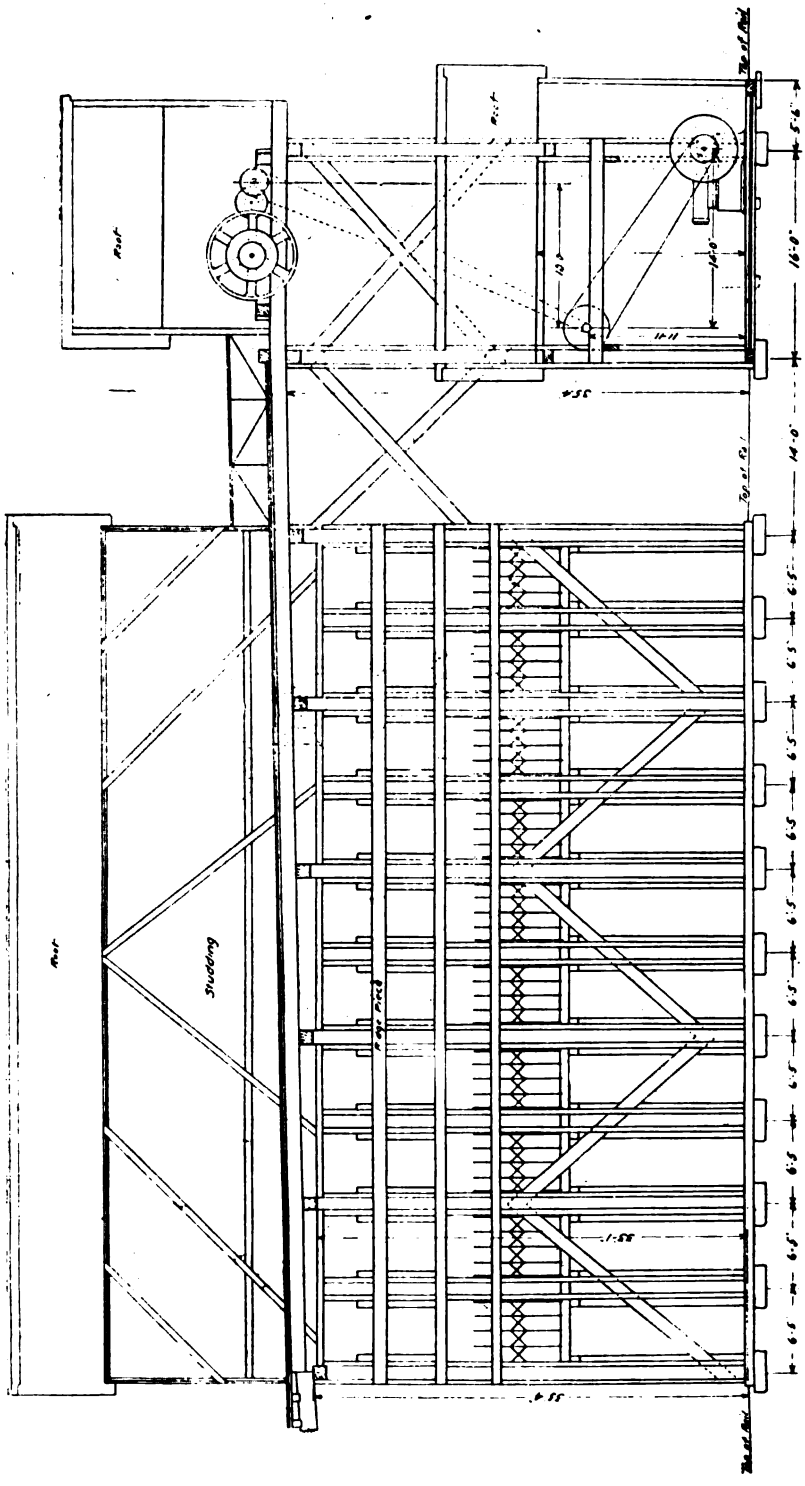
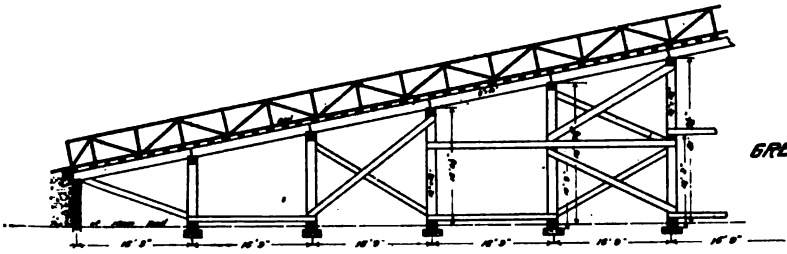
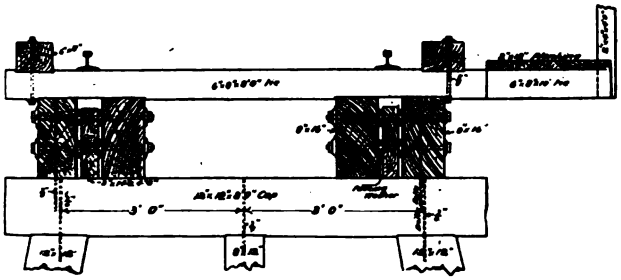


Fig. 28. Double Pocket Coal Chute, Cross Section, Great Northern Railway.


Roof
Roof
Studding
Floor
Top of Rail
Top of Rail
14'-0"
16'-0"
6'-6"
6'-5"
6'-5"
6'-5





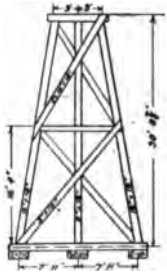


Fig. 30. Great Northern Ry., Coal Trestle.

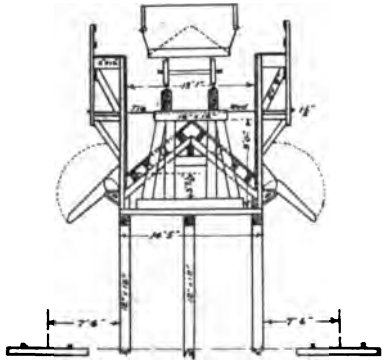


Fig. 31. W. & L. E. R. R. Coal Pocket.

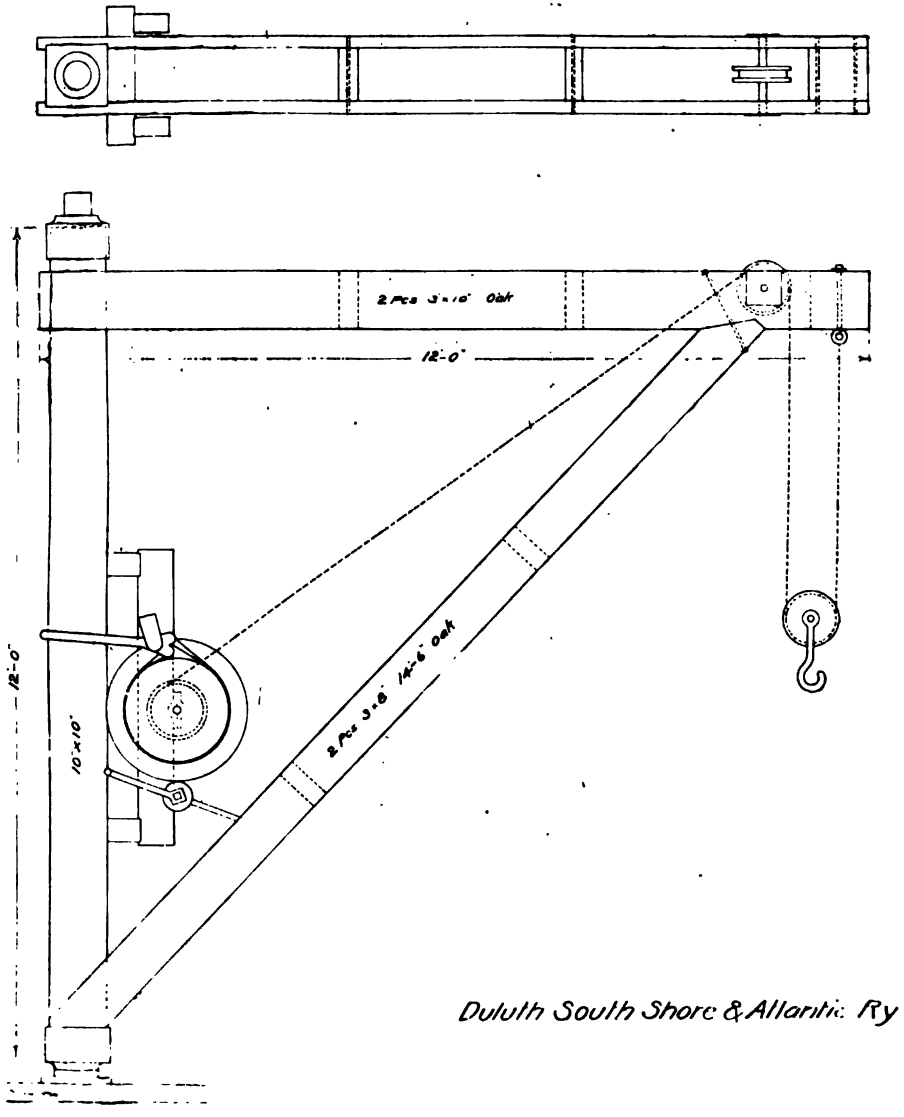


Fig. 32. Coaling Derrick, Duluth, South Shore & Atlantic Ry.

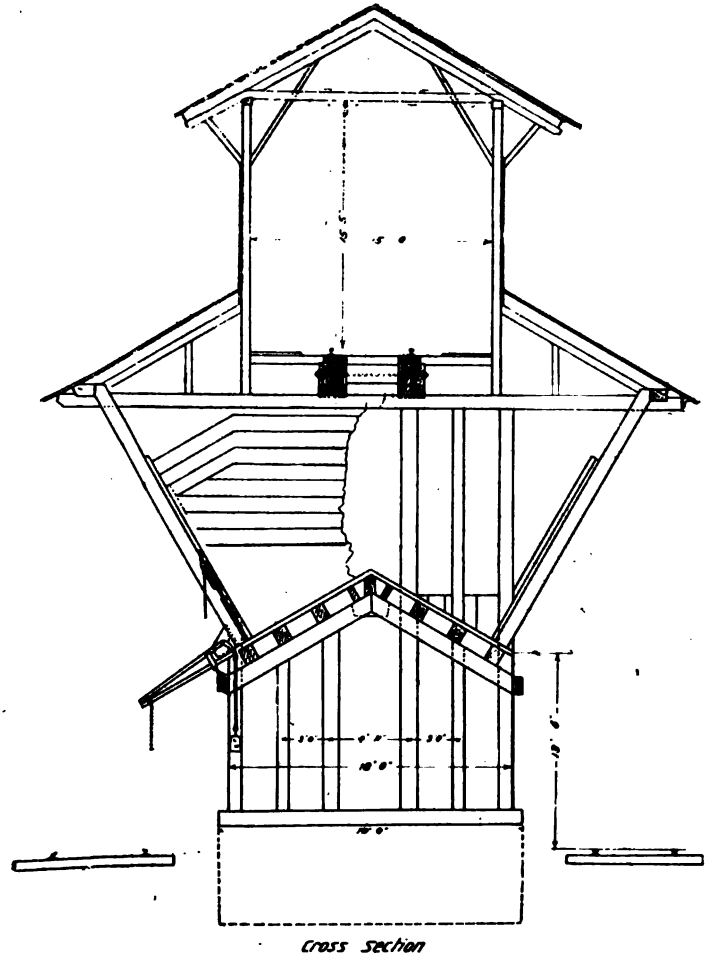


Fig. 33. Coaling Plant, P. & R. Ry

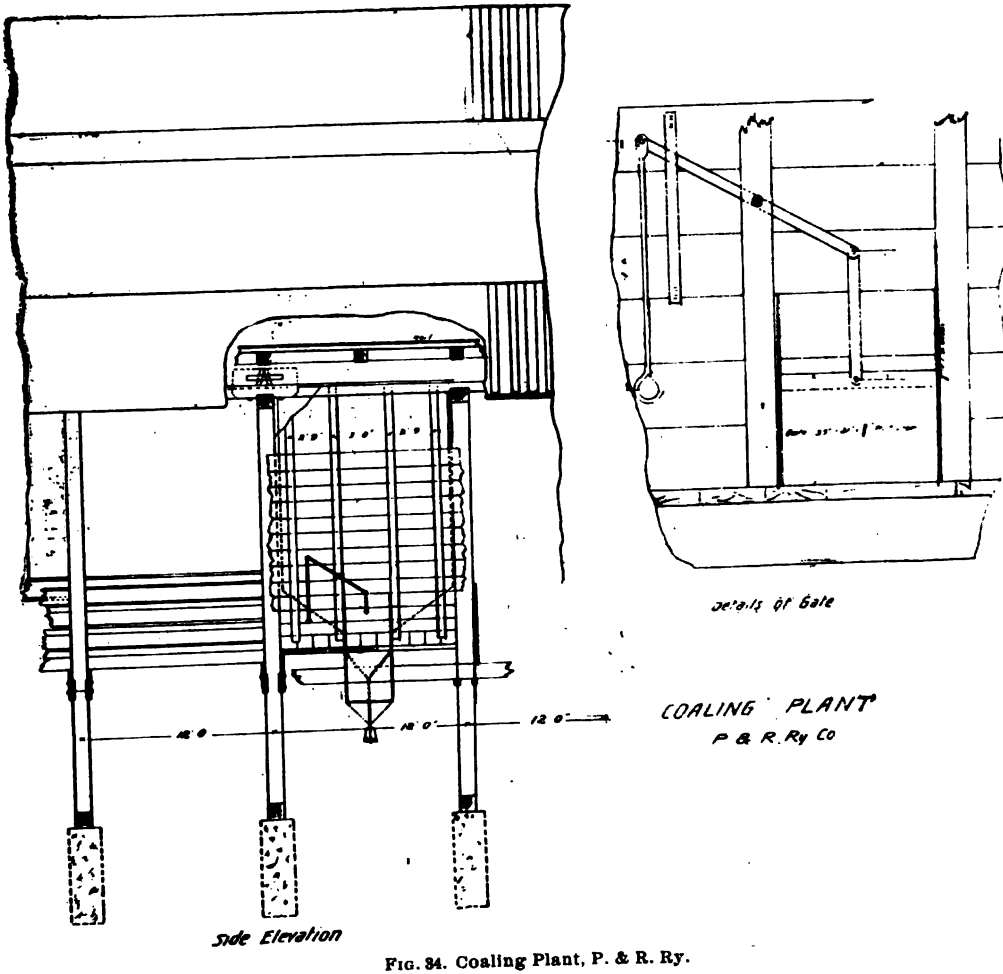


FIG. 34. Coaling Plant, P. & R. Ry.

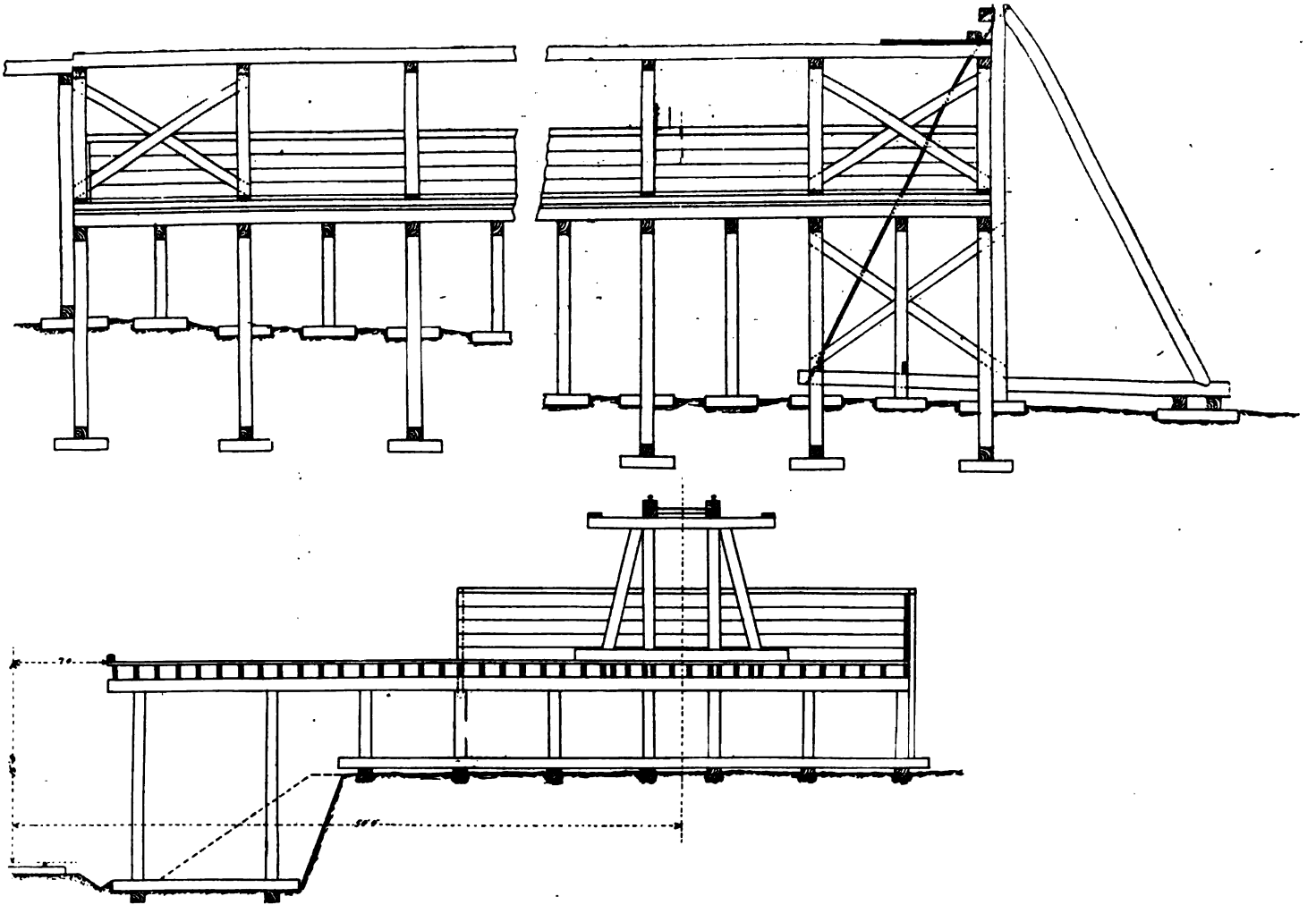


Fig. 85. Coaling Station, Seaboard Air Line Ry., Aberdeen, N. C.

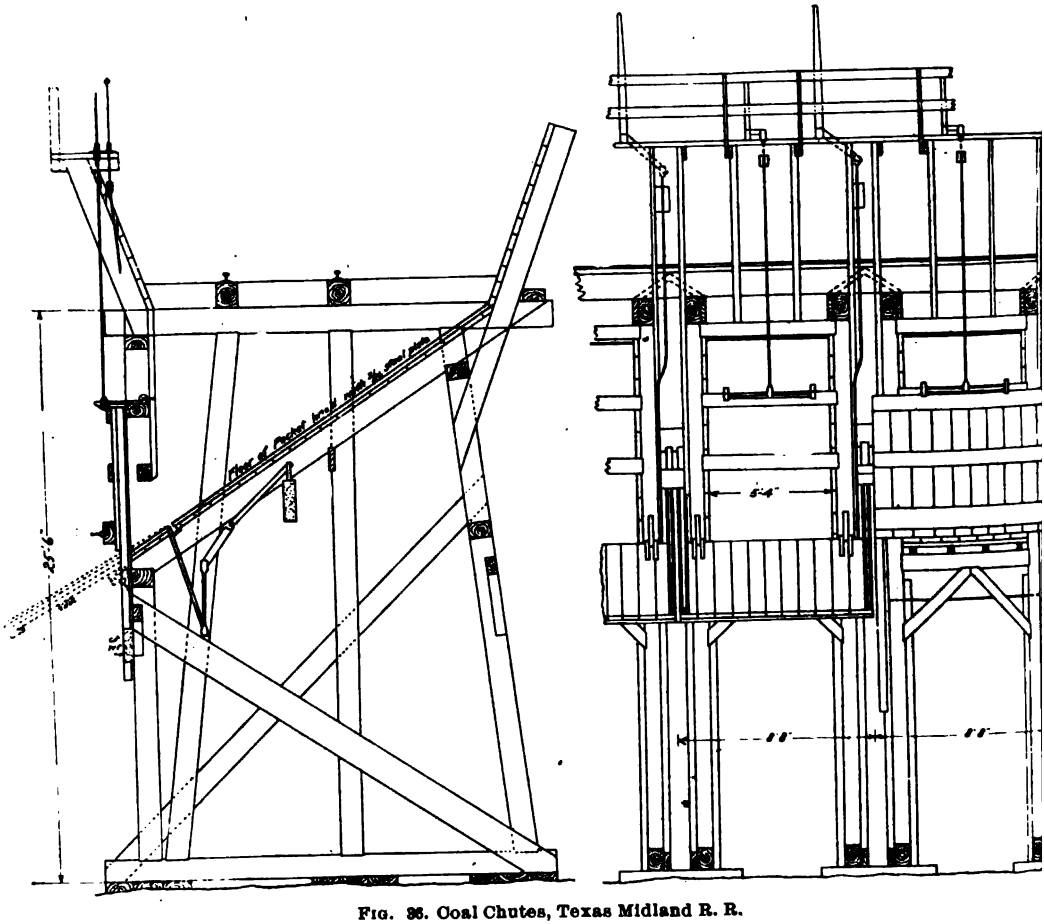


FIG. 36. Coal Chutes, Texas Midland R. R.

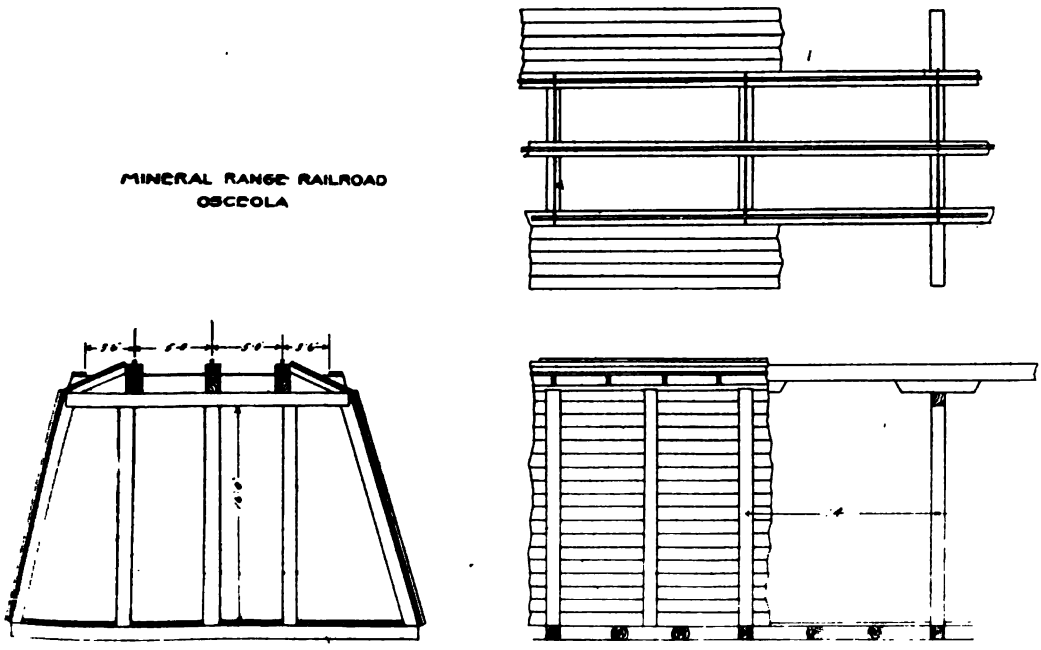


Fig. 37. Coal Trestle, Mineral Range R. R.

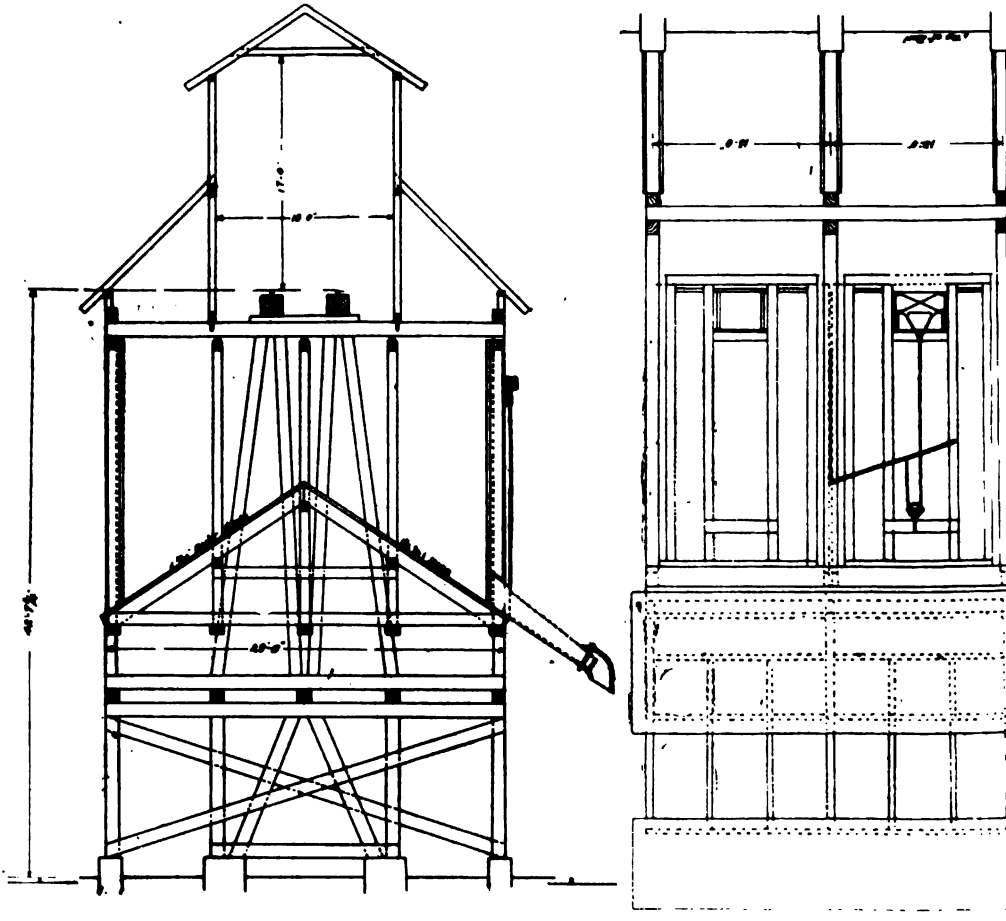


Fig. 38. Coaling Station, Lake Shore & Mich. So. Ry.

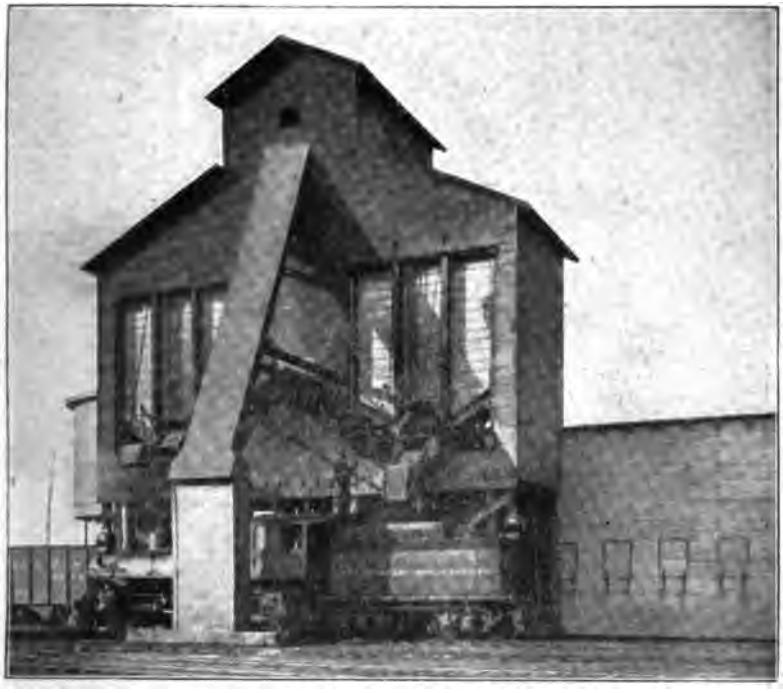
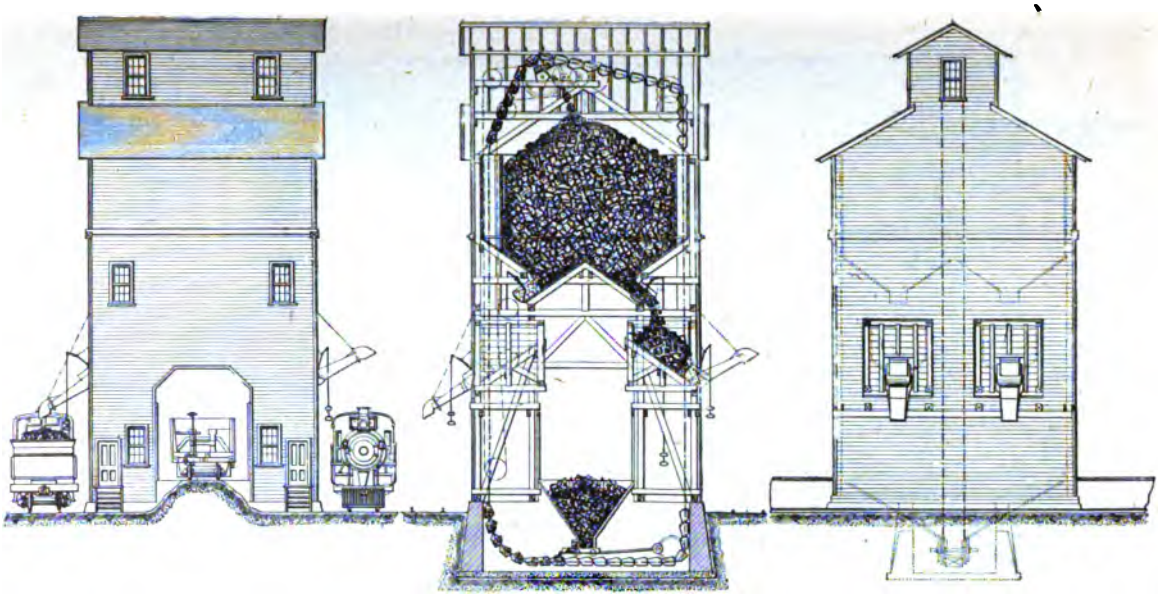


FIG. 39.—Link Belt Terminal Station, having two 60-ton coal pockets, on scales, wit cinder bin, and cinder and sand-handling equipment. Erected for Chicago & Alton Railway, at Roodhouse, Venice, Slater, and Kansas City; also for Union Pacific Railway, Cincinnati, New Orleans & Texas Pacific Railway, etc. A very compact and efficient type, operated by one man.

FIG. 40.—Link Belt Coaling Station, erected for Chicago & Alton Railway, at Bloomington, Ill., comprising two 60-ton coal pockets, on scales, with sand-handling equipment. A modification of the type shown by Fig. 39.



Cross Section *Side Elevation*

FIG. 41.—Link Belt Coaling Station, now in process of construction for Lake Shore & Michigan Southern Railway, at Wick, Ohio. One 500-ton storage pocket, and four 10-ton scale pockets. Operated by one man.

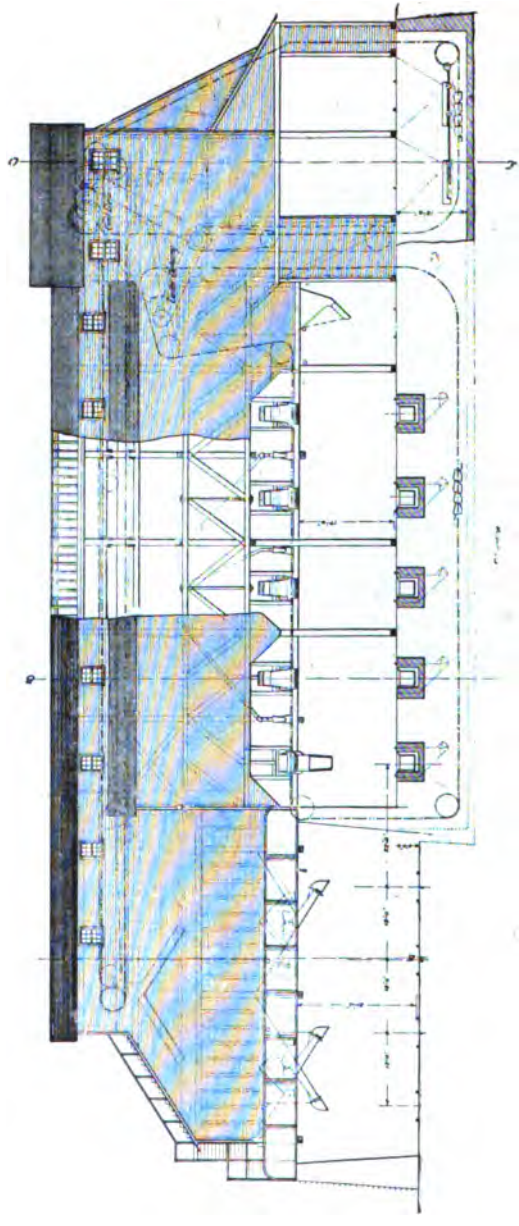


FIG. 42.—Link Belt Coaling Station, Pennsylvania Lines.

FIG. 43.—Link Belt Coaling Station, as erected for Baltimore & Ohio S. W. Railway, Lake Shore & Michigan Southern Railway, New York Central & Hudson River Railway, Erie Railroad, and others. 500-ton fixed coal pocket, delivering coal to locomotives on either of two tracks. One man required during the day only.

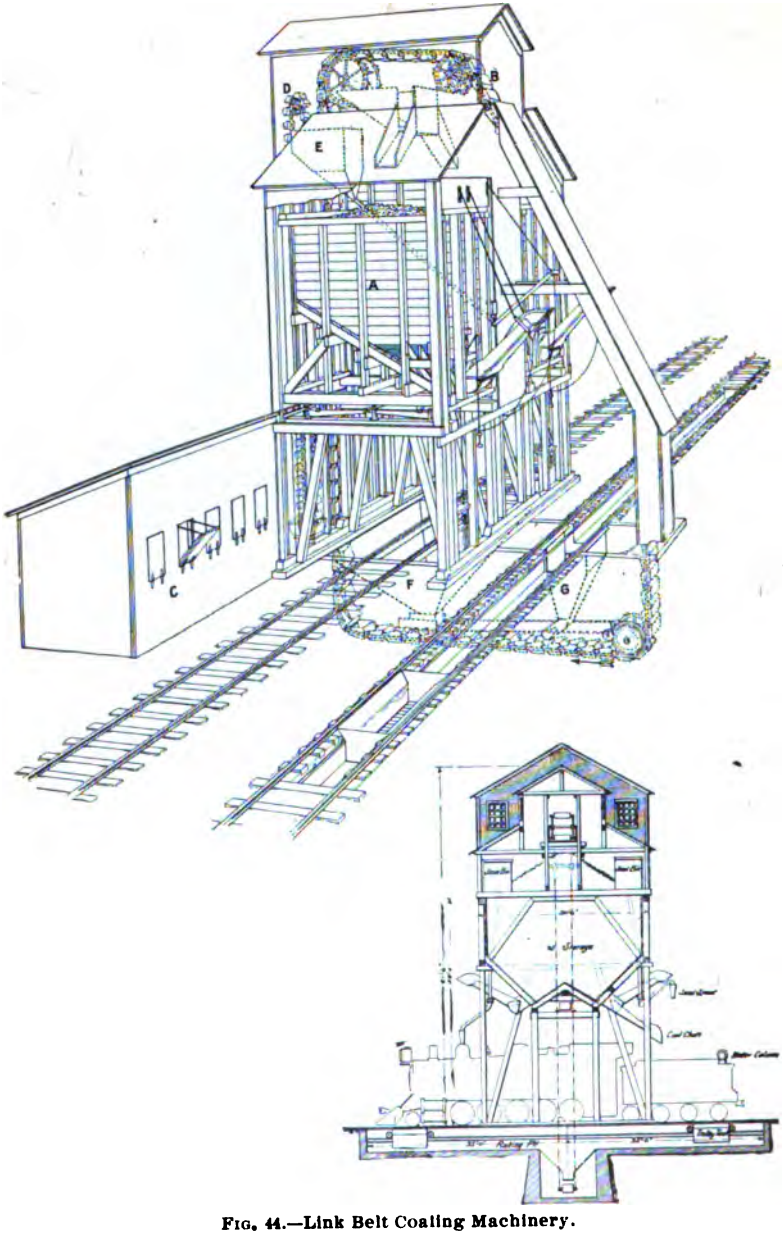


FIG. 44.—Link Belt Coaling Machinery.

DISCUSSION.

Mr. McGonagle.—Mr. President and Gentlemen. I do not know of anything that I can add to the report of the committee. The report is now in your hands for discussion, and the committee hopes that each member will contribute from his experience such points as the committee have not already covered in their report. If any member has anything new, or any particular device not mentioned, we will be glad indeed to hear of it on the matter of cost of coaling locomotives. The point has been raised several times to-day in regard to this term auxiliary coaling station. The understanding of the committee is, we were not to discuss terminal stations in any sense whatever, only the minor or auxiliary coaling stations, such as those at the intermediate stations on the right of way, and the best means of operating them. The matter of terminal stations will form a very excellent subject for discussion at some future time. I therefore think our report in this case should cover only what the subject was intended to cover, that is, intermediate stations on a railroad, and will be glad to hear from every member of the Association.

Mr. Lichty.—I would just like to say that at Fond du Lac, Wisconsin, there has recently been installed a pretty nice coaling station which is fully illustrated and described by Mr. Camp in the last number of the *Railway Review*, and I would rather you would get your information from that. The chute is built pretty high with a steep incline trestle, twenty per cent. grade. The cars are thirty and forty tons capacity drawn up by a cable operated by a 21 horse-power gasoline engine, and are drop-bottom pattern cars. The coal is broken up at the mines where it is put into the cars so that it will drop out of the cars easily and pass through the chutes readily. This plant is more fully described in the *Railway Review*, and you can get a very good idea from that. The coal is handled at a cost of three and eight-tenths cents per ton from these drop-bottom cars.

Mr. Rettinghouse.—In connection with Mr. Lichty's re-

marks I would like to say that at the first coal chute on the Northwestern, put up at Ashland, Wisconsin, we found that the hopper or pocket did not have slant enough. I believe you found the same difficulty at Fond du Lac.

Mr. Lichty.—No, sir, they have been working all right.

Mr. Rettinghouse.—Well, your superintendent advised us to the contrary, and said the trouble was that in dumping the coal in there the fine coal all settled down to the bottom, and one man gets all the lump and the other man gets all the slack. We have been thinking about changing the slant of the bottom part to overcome that difficulty. Another difficulty is, in connection with it, that there is no means of weighing the coal. You simply have to guess at it. There is nothing of that kind provided for, but that might be overcome by a track scale.

Mr. Lichty.—I would just say in addition to my remarks that we did have more or less difficulty with the coal before we ordered it to come broken. When there was slack coal and very large lump coal in the same car I think there was some difficulty in operating them.

Mr. Montzheimer.—There is one great objection to handling coal in chutes of the description just mentioned, if you cannot weigh the coal into the engine. I know that I have heard motive power department people say that while they may save a few thousand dollars in handling coal in a chute of that kind, they can prove that they have lost twenty-five thousand dollars or even more, in coal wasted by engineers and careless firemen because they knew that the company had no check on what they were using. While, of course, it is not necessary to have a scale at some of the chutes, I think it ought to be measured or weighed in some way, and we have these large chutes where it is weighed and it seems to me that it is well worth what it costs for installing it.

Mr. Canty.—One system we use to a great extent is the Williams-White system, but this does not provide for storage. At several coaling points fitted up with this style, criticisms have been made by the fuel department, on account of being obliged to hold so many cars to make sure of a supply.

Mr. McGonagle.—The Williams-White company provide a

system of overhead storage in addition to storing in bins. This is a recent improvement in their coaling device and a very important one. One of the most important points on this subject has simply been touched here to-night, that is the idea of weighing coal. My personal idea is that all the money spent in weighing coal for engine use is simply wasted. I have never in my experience seen any practical results from weighing coal for engine use. I think it is all right to weigh it when you buy it, but to be dealing out coal to locomotives and running a system of accounts requiring a large number of employees to keep track of what each engine uses, I think it is wasting money. You can find out, of course, whether one man uses more coal than another, but my personal idea is that if the railroads will spend a little more money for competent traveling engineers and a little less in running accounts for determining the amount of coal used on each particular locomotive, the result to the stockholders would be very much different than at present. The committee's report, as you have probably noticed, did not touch on this question of weighing coal at all, we considered that this point might arise in the meeting, and while it is one of the most important points at issue we desired rather to have it brought out in the discussion than to say arbitrarily in our reports that we recommend that the coal be not weighed, as I judge it is simply my personal opinion that this money expended in weighing coal is wasted. I do not believe the Convention will agree with me at all. No more danger of it than that the accounting officials of the railroads will agree in any respect to reduce the number of employees. It may not suit the accounting department, but I speak in the interest of the stockholders of the railroads and think that we should cut out this useless extravagance in expending all this unnecessary money in weighing coal for engine use.

Mr. Montzheimer.—In regard to the subject of weighing coal to locomotives it seems to me there are lots of good points in the position that most roads take now on this subject. You could not put enough traveling engineers on a large system to properly check the using of coal in engines. While the traveling engineer is on the engine the fireman might fire a little

more economically, but just as soon as the traveling engineer gets off he will begin wasting his coal again. Furthermore, the cost of traveling engineers, in my opinion, will far exceed the cost of keeping track of the coal used per month on railroads. It does not cost much to compile those figures, it is comparatively a very small expense per engine, and I know it gives good results and proves a saving, and the consequence of keeping track of what they use creates a sort of rivalry between the different engineers as to how far they can run on a ton of coal, and I think it has a good effect on the employees.

Mr. Cummin.—Mr. President. I might like to say a few words but Mr. McGonagle knocked me out in his remarks. He said you did not want any remarks on terminal coaling stations. Now our road is a peculiarly situated road; while we have three hundred and ninety-seven miles of track, yet at the same time it is all cut up in branches; the consequence is that about ninety per cent. of our engines are coaled in one place, and without you care to know about our coaling arrangement at that place I cannot tell you anything at all. We have just finished a coaling station, last June, at Long Island City. It is located with one end of it right on Newtown creek so that we can receive the coal either by cars or by boat. We have the Link-belt conveying machinery in it and it will coal five engines at a time. The storage bin holds three thousand tons, while the delivery bin holds about eighteen hundred tons. We have a traveling crane on a track next to the creek, with a clam-shell bucket which handles it out of the boats and drops it into the hopper and into the conveyor. The expense of handling coal is two and seven-eighths cents per ton from the cars and three cents from the boats. That has been the average cost per ton, since it was opened up last June, for putting the coal into the engine, that is, from the time that we receive it until delivered into the tank. I got these prices from the foreman who has charge of the plant. Our coal bins out on the road, with one or two exceptions, are simply platforms which hold about three car-loads of coal for use in case of emergency. That is the "Armstrong" system that you speak of in your report.

President.—Mr. Sheldon, we would like to hear from you on this subject.

Mr. Sheldon.—I have nothing to say, as all coaling stations on my division are in the class described in the report as antiquated.

Mr. Killam.—Mr. President, I will say that our system of coaling is something on the old style. We have coaling stations about every one hundred miles along the line, with intermediate stations for a few hundred tons for emergency use, or to be called on in case of storm in the winter time, but they are now talking of putting in the patent improved machinery, such as spoken of here, in some places with which it is claimed they can put the coal in the engine for three or four cents per ton. We do not weigh at all, only as we buy the coal.

Mr. Large.—Mr. President, on the division that I am connected with we use altogether the incline trestle on about a three or four per cent. grade, and just push the car up and let it stand on the incline and when the car is emptied drop it down and put another in its place. On my division, we do not pay any attention to weighing the coal, except as Mr. McGonagle says, we weigh it to be sure that we get what we pay for, trusting to the men to deal it out among themselves correctly.

Mr. Ingalls.—Mr. President, on the division I am on we are using the McHenry coaling station, where the coal is dumped into a hopper and then elevated into pockets. At some of the coaling stations we have four pockets on the main line and at the others we have two, holding thirty-five tons each. The four pocket docks have a storage under the pockets for 350 tons of coal. We also have on these docks a device for weighing the coal as it is taken from the pocket. The pockets rest against a dynamometer, which is connected by pipe with a dial on the front of the posts between the pockets. This dial registers the amount of coal in the pocket and the amount taken out is shown by the difference in the position of the hands on the dial.

Mr. McGonagle.—In regard to the dynamometer in connection with the McHenry system on the Northern Pacific Rail-

way, I will state from my experience that on a number of other lines where the dynamometer is used it keeps about two or three men busy to keep it in repairs. Now these are the facts as reported to me, but quite a number of the railroads are using that device. The Duluth and Iron Range Railroad have quite a number of those McHenry pockets installed and from the experience of a number of other lines we omitted the weighing device as it simply complicates matters and adds to the cost of coaling locomotives. *There* was a case where *one* railroad benefited by the experience of quite a number of others. I am very glad this point of weighing has come out; we have now two exactly opposite opinions in regard to weighing coal,—the opinion of Mr. Montzheimer that it is a good thing to weigh it to check the engineers, and my own opinion, that it is money thrown away. There might be some common ground where we could meet and agree on a certain amount of expenditure of money that would give us something like a practical result. As shown, where coal is measured out to locomotives the weight is largely guessed at; you fill the pocket to a certain mark on the pocket, generally indicated by an iron strip, and when filled to a certain height that is called five tons and if it is filled to a certain other height it is called four tons, and so on down to one ton. All this is largely guess work and I think it very much better to take the actual weight of the coal charged at the dock and average it to the locomotives according to the number of miles run and charge it out in that manner, than to guess at it as done on every railroad in the United States. I except none, and think I know what I am talking about. This matter of weighing coal resolves itself down to whether we are going to spend money to guess at what our engines use, or a rational basis and work on known conditions, and charge the coal out to the locomotives according to their mileage from known weights; this can only be done in the way I have stated.

Mr. Markley.—One point has not been brought out in reference to weighing coal and one which makes still more uncertainty, as Mr. McGonagle says, and that is an engine coming in off the road will perhaps arrive with from one to three

tons in the tank and the engine going out gets five tons put on and is charged up with five tons only when it may have seven to eight tons on, depending on how much was left in on her incoming trip.

Mr. Ingalls.—As to the dynamometers on the Northern Pacific, I would say that one man has charge of all the weighing devices between St. Paul and Billings which takes in about thirty coaling stations. This one man has no trouble in keeping up the necessary repairs and we have had very few complaints on our system from the working of the weighing devices. With proper care, I see no reason why they could not be made to work on any other system. When first installed we had some little trouble, but after one man took charge and made a specialty of that line of work, we have had no trouble and they have given good satisfaction.

Mr. Mallard.—I am in favor of weighing or measuring the coal because it certainly pays to have a check on the men.

Mr. Cleaveland.—We have several kinds of coaling stations, but the most satisfactory coaling station that we have is where we have an inexhaustible supply as long as the miners keep at work. The coal trestle is right directly opposite the mouth of a coal mine and they run the pit cars right out on top of our coal pocket, which is about forty feet above the track, and dump the coal into the bins. These bins hold one hundred and forty-five tons each.

Mr. McGonagle.—I believe we have covered the ground on this matter of coaling stations for this year. The matter has been brought up in this way to simply get us to thinking about the subject, but I think the matter could or should be passed at this time and taken up at some future occasion as a subject; in the meantime we can all gather experience and be much better prepared to discuss it. I therefore suggest that this subject be passed.

III. Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expenses for Various Classes of Railroad Buildings.

Paper by J. P. Snow, B. & M. R. R.:

For the purpose of opening a discussion on the subject of roof coverings a partial review of the report presented at the Denver meeting of the Association in 1897 on "The most Suitable Material for Roofs," with comments thereon will perhaps be of service. This report was discussed quite fully at the Denver meeting and also at the Richmond meeting in 1898.

The sentiment of the members generally favored slate for station buildings of importance where a proper pitch could be had and where the roofs did not require much climbing over for the purpose of repairing skylights, telegraph wires, etc. Intances of thirty-five to forty years satisfactory use were cited. Slate should be of good, tough quality and should be not over ten inches wide and long enough to give three inches head cover under the third course above, and should be nailed with copper or composition nails if exposed seriously to engine smoke. The pitch of roofs covered with slate should be at least six inches per foot.

Vitrified tile was mentioned to some extent; but the experrience of a few members had been unfortunate with it. When rightly made and laid, however, on very steep roofs its durability is unquestioned. It is probably not well adapted for ordinary railroad buildings.

Shingled roofs were well spoken of with records up to 28 years. With a pitch of six inches per foot or over and where the fire exposure is not great, shingles are preferred by many for ordinary buildings where slate would be too expensive. Composition nails must be used for roofs under which engines pass. The best sawed shingles now obtainable in the Eastern markets cannot be depended on for more than fifteen years.

For flat roofs the preference seemed to be for tar and gravel, twelve to eighteen years' satisfactory life was cited and longer records up to thirty years are certainly known. Slag is used by some instead of gravel and broken stone of pea size is substituted when gravel is not to be had. Much depends on the quality of the paper and pitch used and on the thoroughness of the work done in putting on the roof. Three, four, and five-ply roofs were mentioned. It is probable that three-ply is entirely too light for permanency. Four-ply makes a good roof, but five-ply is better. The sheets, except the top or mop sheet, should lap so as to have one and a half to two inches of head cover, be mopped between the sheets and nailed not over eighteen inches apart on their lower edges. The top sheet should be mopped on and covered with a flowing coat of pitch into which the gravel should be pushed. Asphalt paper and

asphalt pitch is preferred by some to coal tar products but it is probable that with proper stock, coal tar is sufficiently durable. On account of its liability to run in hot weather an asphalt gravel roof should not pitch more than one half inch per foot, while a tar roof may pitch one inch per foot. Such very flat roofs as are required for asphalt will form a hollow and retain water if any settlement occurs from shrinkage of timber or other cause while a more generous pitch will still preserve a slope with an equal amount of settlement.

Sheet metal roofs either corrugated or flat were not found to be durable by those having experience with them. Steel is more rapidly corroded than iron. When much exposed to engine gases its life is hardly more than one year.

Tinned shingles of good quality, like the Cortright, give good satisfaction. Painted steel shingles are short-lived unless painted frequently.

Of the many patented roof coverings, Sparham, Ruberoid and Perfected Granite are as good as any. Sparham is a pulverized talcose lime rock mixed with coal-tar pitch and applied to the roof when hot with a trowel. It can be used on a flat roof or on a pitch of three or four inches per foot. Ruberoid is a wool felt saturated with a paraffin preparation by the Standard Paint company, and put on with cemented laps.

Perfected Granite Roofing is a two-ply tarred paper with sea grit about one-eighth inch diameter, rolled on to one side. It is laid with cemented laps the same as Ruberoid. That made by the Eastern Granite Roofing company of Jersey City is very good. Many cheaper makes are unsatisfactory. Both the Ruberoid and Granite Roofing may be laid on any pitch not flatter than two inches per foot. With proper care in laying they make good roofs, and records of ten years' life are not unusual. The material should be put on in warm weather and it should be unrolled and allowed to expand before it is secured to the roof. Neglect of this precaution will cause it to buckle up between the nailings and eventually crack.

Other ready roofings are John's asbestos, mica roofing, paroid, a prepared burlap, and plain two and three-ply tarred paper. The latter is the cheapest of the lot and is serviceable for a few years if intelligently put on and faithfully cared for; three-ply should be lapped two inches, cemented and closely nailed, and mopped with asphaltic cement and sanded, or a better roof may be made with two-ply lapped one half the width of sheet, with a little head cover closely tacked and mopped and sanded. Every two years these roofs should be mopped over with an asphaltic mixture and sanded. A pitch of two inches per foot is about right. If too steep the cement coat will run badly. With this treatment these roofs have a record of ten years and are still in good order.

The trouble with any cheap roof that requires mopping over periodically is, that on a railroad, work of this sort is seldom

done until leaks are reported. When one of these roofs gets to leaking badly it is beyond repair by simply mopping it with any cementing mixture; but if the mopping and sanding is done regularly about once in two years, before the felt gets bare so as to leak, the covering can be preserved almost indefinitely.

A roof that requires a coat of cement every two years can hardly be called a permanent roof and it may be fairly said that it is not consistent to put any cheap ready roofing on permanent buildings. Slate for pitch roofs, and tar and gravel for flat roofs, can be recommended as being the nearest approach to permanency of anything within reach of railroad men.

As to cost, much depends on locality and the method of charging labor. In New England, we can say that first-class roofs of various kinds will cost about as follows per square:

Slate	$ 9.00	to	$12.00
Tile	30.00	"	33.00
Sawed cedar shingles	4.50	"	5.00
Tinned shingles	5.00	"	6.50
Sheet tin with standing seams	6.50	"	8.00
Tar and gravel	4.00	"	5.00
Sparhan	5.00	"	5.50
Ruberoid	2.75	"	3.75
Perfected granite	2.75	"	3.25
Paroid	3.00	"	3.50
Two-ply laid double	2.00	"	2.25
Three-ply laid single	1.50	"	2.00

Respectfully submitted,

J. P. Snow,

Member of Committee.

DISCUSSION.

Mr. Markley.—Only one word in reference to the cost of tile. In the paper just read from Mr. Snow the price given, if I remember correctly, was thirty-three dollars per square. We buy Ludowici Roofing tile for ten dollars per square for hip roof buildings which includes hip rolls, finials, ridge, caps, and terminals. Plain double pitch roofs, only $6 per square. Size of tile 8 x 13 ¼ in., or 136 in., per square; this does not include the cost of laying, which is about 75 cents per square. We are using them very extensively on our line, with good results on brick buildings.

Mr. Pickering.—That is the New England price for roofing laid.

Mr. Cummin.—I was just going to mention that Mr. Markley probably lives where they make tile. Mr. Snow lives eight or nine hundred miles from where they make it, and that makes a vast difference about the price of it.

Mr. Markley.—I was talking about where I worked.

Mr. Montzheimer.—Mr. President, on the Northwestern we have been using gravel roofing for a number of years, practically all over the entire system, and it costs about two dollars and one half per square for four-ply gravel roof, but we do not nail the tarred-felt; in fact, I think there are good objections to the nails, because they rust out, and where they do this they leave a hole for the water to get through. We use what is known as the Ready-Rock Asphalt Roofing, and it has a burlap back to give it strength. We buy that for two dollars and twenty-five cents per square and put it on for thirty to thirty-five cents a square. It makes a very cheap roof and we have had no leaks whatever for the last three or four years. On most slate roofs we are using copper nails now; use some cedar shingles, and would say we also make some of our shingles out of pile heads for seventy-five cents a thousand; last year made seventy-five thousand out of old pile heads which would have been practically lost if we had not used them in this way.

Mr. Cleaveland.—Would like to ask the gentleman if he has painted this burlap since it was put on four years ago.

Mr. Montzheimer.—This burlap is merely put on the under side for strength, the top coating is asphalt and some other composition and is covered with fine lake-washed gravel. We have never done any work on the roof since it was put on and it is practically the same as a gravel roof.

Mr. Powers.—This Ready-Rock that the gentleman speaks about we put on quite extensively some five or six years ago, and every roof put on is ready for repairs now, that is, the Waukegan roofing.

Mr. Montzheimer.—I guess the first roofing they made did not have the burlap back, they made some with brown paper, and that is what is giving the trouble.

Mr. Stannard.—Mr. President, I do not know as I have

much to say on this subject; would prefer to hear from some of the other members. Will say, in this connection that we use slate, gravel, burlap, Ready-Rock and shingles, and would like to find, if possible, something better than shingles. We lose several buildings yearly by shingle roofs being set on fire by sparks from locomotives.

Mr. Powers.—Would like to ask the gentleman in regard to Ready-Rock roofing, what his experience has been with it.

Mr. Stannard.—Referring to the Ready-Rock roofing, will say, have been using this brand for little over five years. It has not given first-class satisfaction; have had to repair several times during last two years; building is now needing new roof.

Mr. Killam.—Mr. President, this roofing question is quite an important one I know on our road; we have two or more classes of roofing, but we have n't any of this patent Rock Roofing. At Moncton on the machine shop, which is two hundred feet by four hundred and fifty feet, we laid a slate roof but it has to be renewed on account of the slate cracking. Has been over thirty years since the roof was put on. We had a great number of buildings covered with iron shingles but we have abandoned them and are getting rid of them as fast as we can; if not painted every two or three years they are soon gone, so we are putting on cedar shingles. Now fire has been spoken of. A roof that has been painted well will not take fire; if it has two or three coats of good paint every few years there is no danger of fire from sparks from locomotives, but a painted roof will not last as long as a roof that is not painted; the only advantage is the protection on account of fire, but cedar shingles put on without any paint on them will last several years longer than if painted. Our buildings where they come in close contact with passing locomotives, the roofs of course, are painted to protect against fire. I know one freight house a little off this side of Quebec; the shingles and paint got in bad shape and when I inspected it I noted in my notes, "If this roof is not repaired and painted in a very short time, a serious fire will occur," which unfortunately did catch fire and burned down a short time after, and it cost some fifteen thou-

sand dollars to rebuild it and damage to freight and cars. Paint will protect from fire, but if you let the roof go, any shingle roof after a time gets a little fur on it, and in a dry time will ignite from a spark and go like tinder, that is the experience we have had with shingle roofs. Now on our road the intention is to get the very best material and what will be the most durable and safest to guard the interest of the public, because the road is owned by the people at large, and not by private stockholders.

Mr. Cleaveland.—For a cheap roof that will not catch fire easily I will state that I have had considerable experience with the Eastern Granite roofing which is a prepared roofing, the gravel being rolled in paper and tar and asphalt, and I covered one of our roundhouses with it about six years ago, which is still good. This summer we had a large fire close to the roundhouse, and the wind blew the burning embers over on to the roundhouse roof. I was not at the fire myself, but the next morning they told me there were embers larger than my hand covered all over that roof and they did not pour any water on this roof and it is still there, so if you want a cheap roofing which is, I think fire-proof, I can heartily recommend the Eastern Granite roofing.

Mr. Alexander.—On our engine houses we use gravel roofs entirely and are well satisfied with them; do not think we can improve on it for engine houses or flat roofs. We use shingles on roofs of stations and freight houses, except a few stations where we have slate roofs, as we are in a place where slate is plenty; we could use it more, but get very good satisfaction with best quality shingles. We have tried rubberoid on several large coal sheds and on some small buildings and feel very well satisfied with it, and find it more fireproof than shingles and about as cheap.

Mr. Lemond.—Mr. President, on our first-class buildings we use slate, principally, and on second class tin shingles, and for roundhouses and freight sheds and buildings, such as have flat roofs, we use a gravel roofing, flintkote roofing, and like materials; we did use some perfected granite roofing manufactured by a concern in Jersey City, but it did not last

more than two or three years, and was not at all satisfactory at any time. A good slate roof, I think, is best for first-class service.

Mr. Cummin.—I think I said all I had to say the last time this subject was before the Association, and would prefer to hear from some of our new members on this; perhaps they can give us some points. I think the last time it was up for discussion, slate, tile, gravel, ruberoid, tin, and shingles were mentioned, and experience was just about as described here this morning.

Mr. Sattley.—I would like to ask Mr. Killam about that slate roof that had been on for thirty years; what kind of nails used in it?

Mr. Killam.—The nails were composition nails, not exactly a pure copper nail, but a mixture of brass, copper, etc., what we call a composition nail. The trouble was the cracking of the slates that caused the leaks in the roof and not the nails. The building was erected in 1870.

Mr. Cummin.—I would state that in the East they manufacture a nail, what they call a composition nail, that has copper in it and other metals; it will last longer than a pure copper nail on roundhouses and that is why we are using them. I have had experience with both kinds and find the composition nail will last a great deal longer than the pure copper nail. The nail is composed of about one half copper and other metals used in conjunction with it.

Mr. Ingalls.—Mr. President, I do not think that I can add anything to what has been said. We use the Carey magnesia roof, slate, corrugated iron, tar and gravel, asphaltum and shingles, and we also have a few tile roofs. We have a slate roof that has been on for over twenty years; the corrugated iron has only been on a little over three years and I have had to paint it once since it was put on. The tile roofs have not been on long enough to pass any opinion on same. The tar and gravel roofs have been on for twelve years but need renewing now. The use of tar and gravel roofs has been discontinued, asphaltum being used in place of same. As to the asphaltum roofs, some have been on seven years, but I have

had to re-coat them once since they were put on. Have also had to re-coat the Carey roof. This Carey roof was put on in December, 1898. On most of the buildings we use shingles and paint them for protection from fire.

Mr. Kelly.—Mr. President, I have listened to what has been said in regard to roofs with great interest and would only say that on our division we are using mostly slate roofs, however, have some shingle roofs, some granite roofing, and some composition tar roofing. Personally I am more in favor of the composition tar roof than I am of the granite. I have a granite roof that has been on two years and expect to take it off this fall; have had to patch it some four or five times this year and I am figuring on putting on a composition tar roof this fall.

Mr. Canty.—The majority of our stations and freight houses are covered with slate roofs which have been on since the road was first built (thirty or forty years ago). They are in fairly good condition now, and we have had practically no trouble with them. We cannot find anything better for a station or a freight house than a slate roof. On engine houses gravel roof.

Mr. Swartz.—On the division that I am on our road is using gravel roofs on engine houses and freight houses, and for stations we are using shingles altogether with galvanized nails. We found out the common wire nails rust out so badly that we have adopted the galvanized nail.

Mr. Austin.—We have used all kinds of roofing on the Western division that I am on. Slate roofs, I think, are the best for stations. We put on slate, which are drilled and counter-sunk, and use composition nails. It seems some of the people out this way don't understand what is meant by composition. They are made of copper, zinc, and tin of certain proportions which I do not know because that is the manufacturer's secret. I think the slate roof is far preferable to anything else where you have a good building to put it on.

Mr. Cummin.—I find that a large number of members of this Association are in the dark as to composition nails. I have already agreed to send the name of the manufacturer to a number of the members and I think it would be well to send

this information to the secretary so that he could incorporate same into the proceedings, showing that these nails are manufactured by so and so and can be obtained at such and such a place.

Mr. Mallard.—If there are a number of gentlemen who wish to know where to get these nails I would suggest sending to the manufacturer a list of the members of this Association and let the manufacturer deal with each individual, instead of our recommending any particular manufacturer in our Proceedings. Somebody else may make those nails.

III.—Mail Cranes: First Cost, Efficiency, and Maintenance of the Various Kinds in Use.

REPORT OF COMMITTEE.

Danville, Ill., Sept. 10, 1902.

To the Association of Railway Superintendents of Bridges and Buildings:

The committee appointed at the last annual meeting held at Atlanta, Ga., October, 1901, submits the following report on Subject No. 3:

"Mail Cranes: First Cost, Efficiency, and Maintenance of the Various Kinds in Use."

As usual a circular was sent to seventy-five of the members of this Association asking for information in reference to this subject. We received some replies to these circulars, copies of which I give you below. It would appear that the Columbia Mail Crane is in pretty general use, and all members being familiar with its makeup, it was not included in this report. Blue prints of the various cranes described below are attached to this report, as well as the various answers to our circulars.

Following is report of Mr. W. E. Smith, of the Chicago, Milwaukee & St. Paul Ry.:

"I have had experience with only one kind of mail bag crane. It is the C., M. & St. P. Ry. Co.'s Standard Crane, as per our B. & B. Dept. Dr., No. 2981, copy of which I enclose. It gives good satisfaction. They used to cost $10, but they cost $11 at present."

Mr. F. E. Schall, of the Lehigh Valley R. R., sends blue prints of three cranes. Special attention is called to the one that is used for swinging across a track adjoining the main track. His report is as follows:

"A number of styles of cranes are in use on this system, the Hauss Mail Crane, the Columbia Mail Crane, and the U. S. Government Standard Mail Crane. All of them are giving satisfaction. The Hauss Crane has been adopted as the Standard Mail Crane by this company. I send you blue print of a U. S. Government Crane, a Hauss Crane, and one crane with swinging arm over track."

Blue prints of cranes used on the Chicago & North Western Ry., are furnished by Mr. H. Rettinghouse. He reports as follows: "I enclose you herewith two blue prints of mail cranes in use on this system. Print marked No. 45 is used on the Ashland Division, it being the standard crane for the Milwaukee, Lake Shore & Western Ry., before same was merged with the C. & N. W. Ry. Print No. 46 is the standard crane for the C. & N. W. Ry. We are still using the crane, as shown on print marked No. 1 on this division, and have never used any of the others."

Mr. Arthur Montzheimer, of the same line, sends blue print and report as follows: "I have twenty-five of my mail cranes in use on the C. & N. W. Ry. They are durable, neat, and an ornament to the station grounds. You will see by the attached plan that they are fastened by lag screws to two long ties, which gives them a firm foundation and always keeps them in adjustment. If the track is raised, the mail crane always maintains its same relation to the track. If on a curve, the mail crane is perpendicular to the tie, no matter which side the elevation is on, and on that account the crane is always parallel to the side of the mail car. As it automatically swings from the track when the bag is taken off, it is safer for the trainmen on the following trains. The crane consists essentially of a cast iron base and a mast constructed of gas pipe. Some of these cranes have been in constant use on the C. & N. W. Ry. for the past six years, and are giving good satisfaction. The cost of maintaining these cranes is practically nothing."

Mr. J. S. Berry, Supt. B. & B. of the St. Louis Southwestern Ry. Co., sends blue print of the standard wooden mail crane, about which he says: "This crane has given universal satisfaction and has been highly commended by the U. S. postal authorities for its efficiency, in fact, is preferred by them to any of the iron mail cranes we have ever tried. These cranes cost us, complete, erected in place, about $19.35, $6.37 of this being labor, the balance material."

Mr. J. S. Lemond, roadmaster on Southern Ry., sends blue print and report as follows: "I enclose blue print showing in detail the mail crane we are using. While this differs in some minor points from the other mail cranes we have used, the difference is so slight it is not worth mentioning. The principles are all the same. We have no device for delivering mails

where side tracks are on both sides of the main line, except where the distance is sufficient between the main line and the side track to admit mail crane. At points where we have side tracks on both sides and the distance between the tracks is not sufficient to admit the mail crane, we locate it beyond the switch even if it is quite a distance from the station."

Attached also find blue print of the standard crane of the Chicago & Eastern Railroad, which has given universal satisfaction. These cranes cost $11.64 set up complete.

The blue prints of these cranes should be lithographed, and if the others so desire I will be glad to have the tracing made of them at the least possible cost, which I assume will be ten or fifteen dollars. It is impossible to describe them without the lithograph.

A. S. MARKLEY,
F. PRICE,
JAMES BRADY,
G. W. SMITH,
D. W. LUM,
Committee.

Mr. Aaron S. Markley (by letter since convention met): As a supplement to the report of the committee on mail cranes, I desire to call attention to the illustrations (Figs. 57 and 58), showing a patent mail crane that is being tested along the line of the Pittsburg, Bessemer & Lake Erie R. R. The illustrations are from photographs sent by our member, Mr. Cleaveland, of this road. The device consists of a gate hung to the side, and over the mail car door, which is reversible, so that mail can be let off at the same gate, no matter in which direction the train is going. This device deposits the bag in a house built alongside of the track, sufficiently close so that when the bag strikes the house it opens the door and deposits the mail bag inside the house. This same gate is hung so as to drop the mail pouch, also at the same time the pouch that is to go on the train. I also present plan (Fig. 59) of mail crane used on the Mahoning division of the Erie railway, forwarded by our member, Mr. J. McIntyre. It costs, complete, $12.

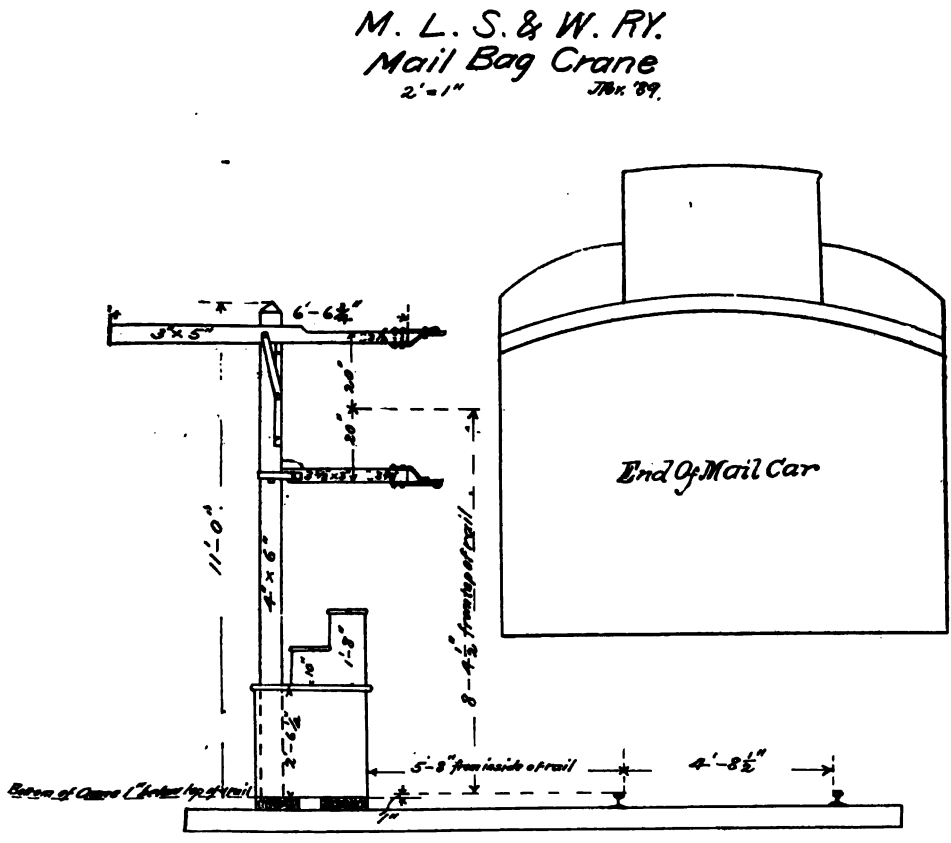


Fig. 45. Mail Crane, M., L. S. & W. Ry.

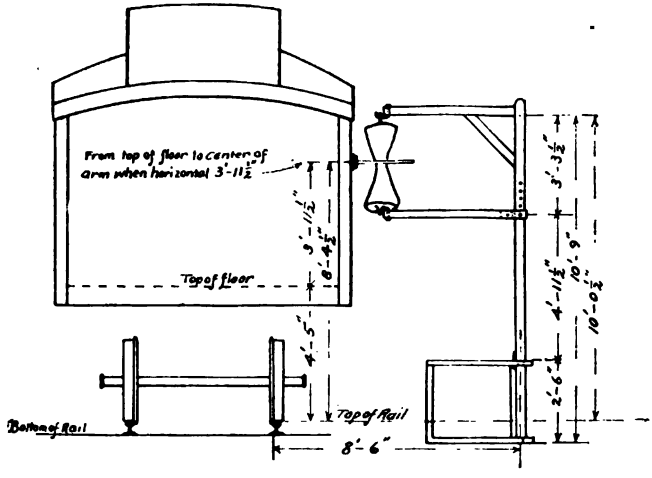
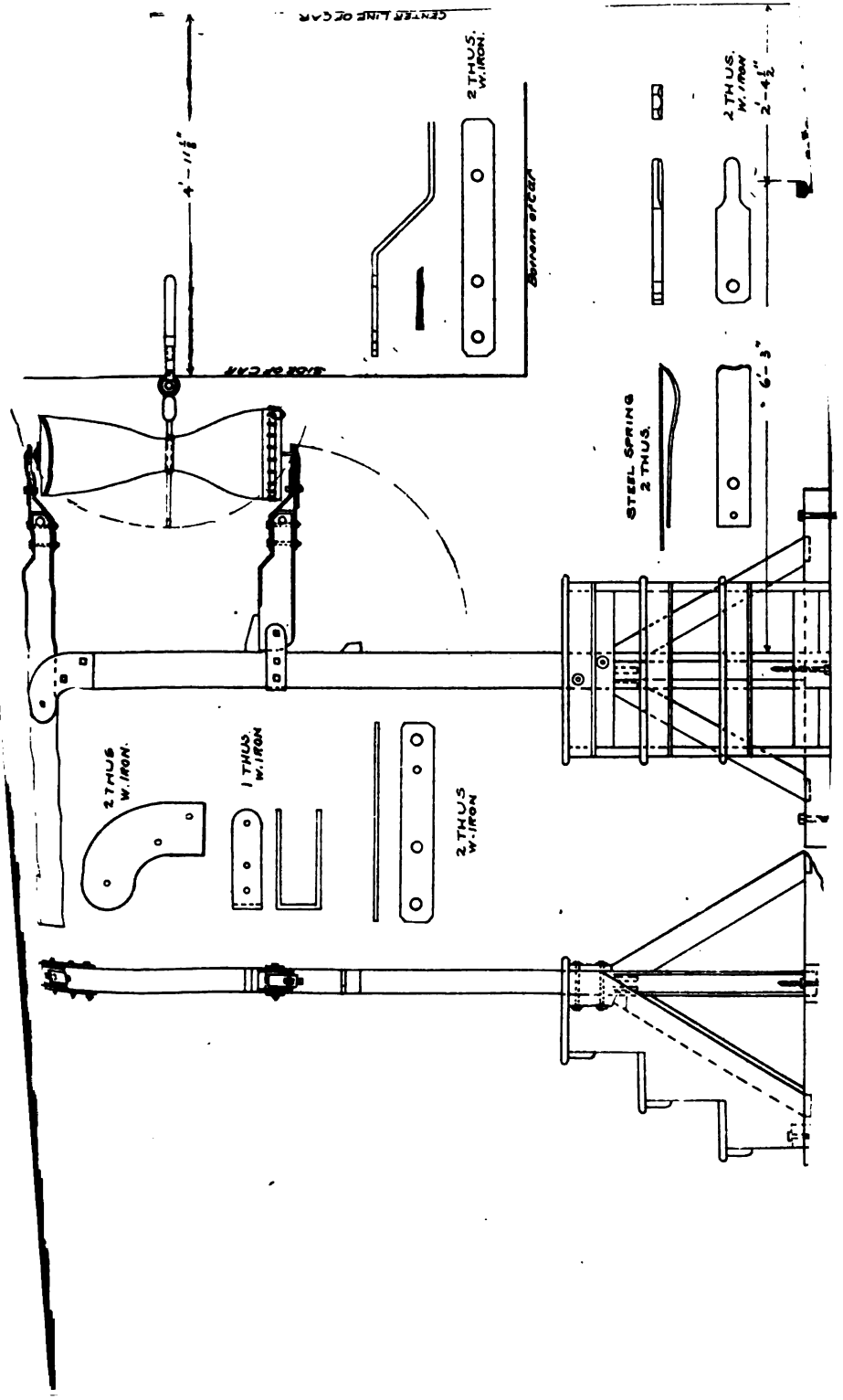


Fig. 46. Mail Crane, C. & N. W. Ry.


CENTER LINE OF CAR
4'-11⅛"
2 THUS. W. IRON.
SIDE OF CAR
BRASS STEEL
2 TH U.S. W. IRON
2'-4½"
STEEL SPRING 2 THUS.
6'-3"
2 THUS W. IRON
1 THUS. W. IRON
2 THUS W. IRON

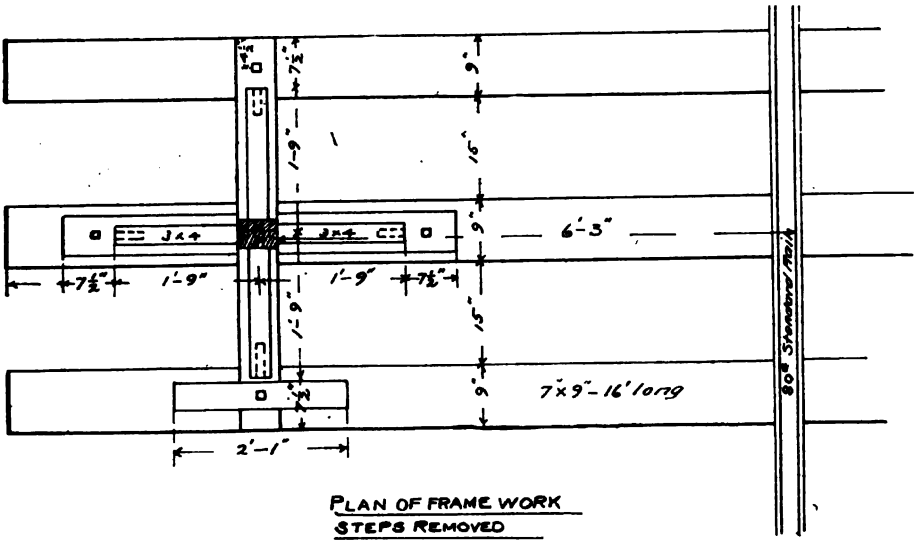


Fig. 48. Mail Crane, Southern Ry.

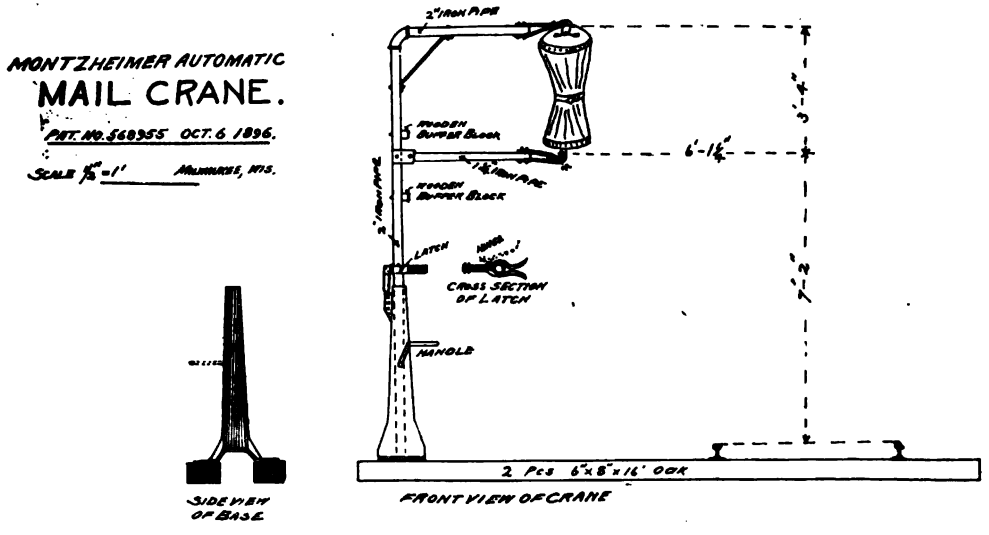
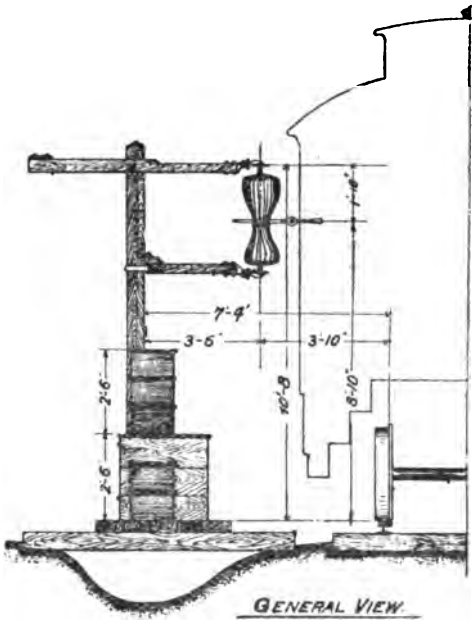


Fig. 49. Mail Crane, Montzheimer's Automatic Action, C. & N. W. Ry.



GENERAL VIEW.

BILL OF IRON.

2 Tongues	A	1 .. Bolt ¾ diam. @ 1/6	
2 Steel Springs	B	5 .. " ¾ " 1/3	
2 Braces	C	4 .. " ¾ " 8½	
2 " (Bent)	D	3 Carriage " ¾ " 7½	
4 Clamp Plates	E	1 " " ¾ " 7½	
2 sq. Washers	F	4 " " ¾ " 9½	
1 Cast Counterweight	G	2 .. " ¾ " 2½	
1 Strap	H	2 Store " ¾ " 0½	
1 Gas Pipe (upper arm		3 Lag Screws ¾ 4"	
1 " " (lower "		10-#18 Wood Screws	2½
2 Washers for ¾" Gas Pipe	1	8-#14 " "	1½
1 " " ¾" Bolt			
16 " " ½			

C. M., & St. P. Ry.

BRIDGE & BUILDING DEPARTMENT.

STANDARD MAIL BAG CRANE.

Chicago, Jan. 4th 1892. Drawing No 2981.

Correct W. H. Finley, Asst. Engr. Approved, Engr. & Supt. B. & B.

Approved, Chief Engr. Approved, Gen'l Manager.

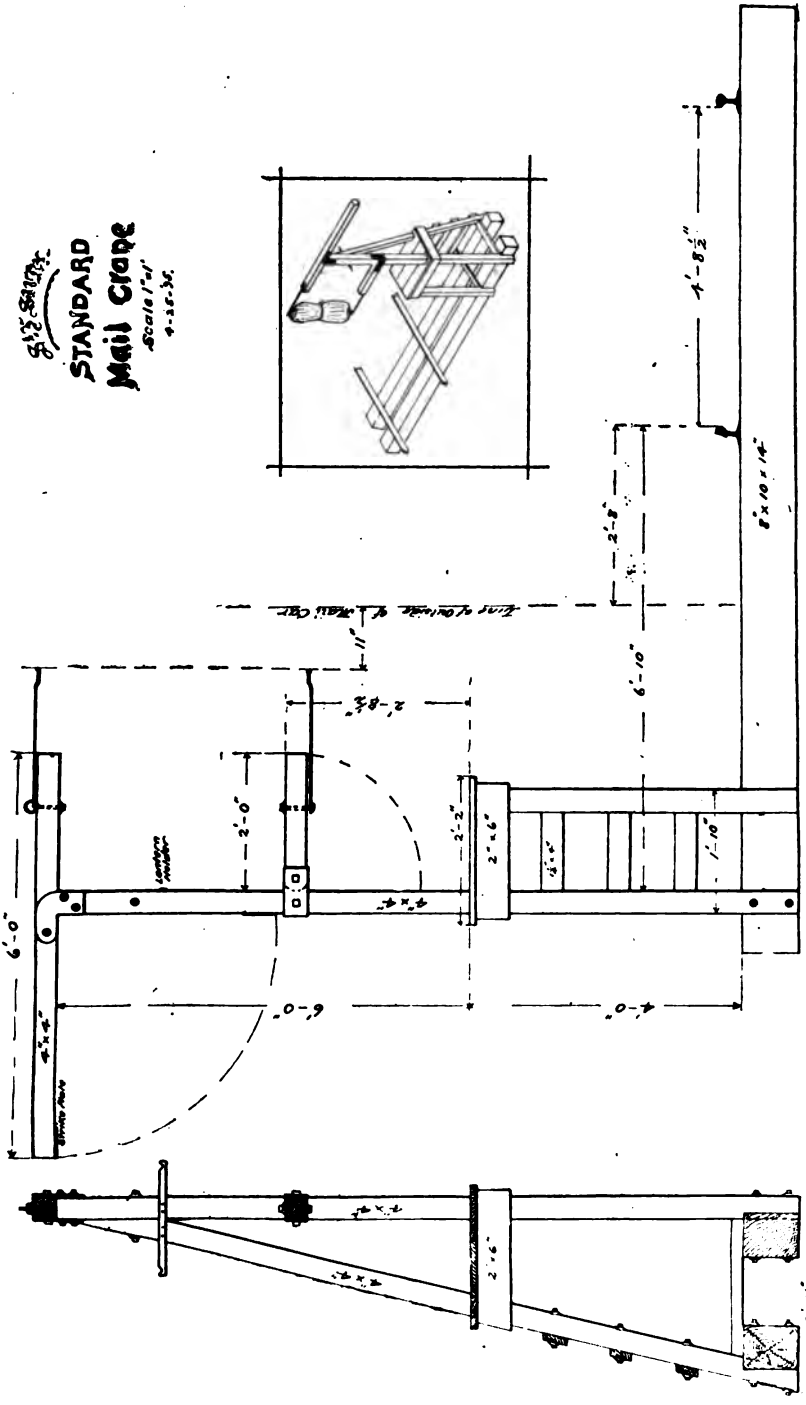
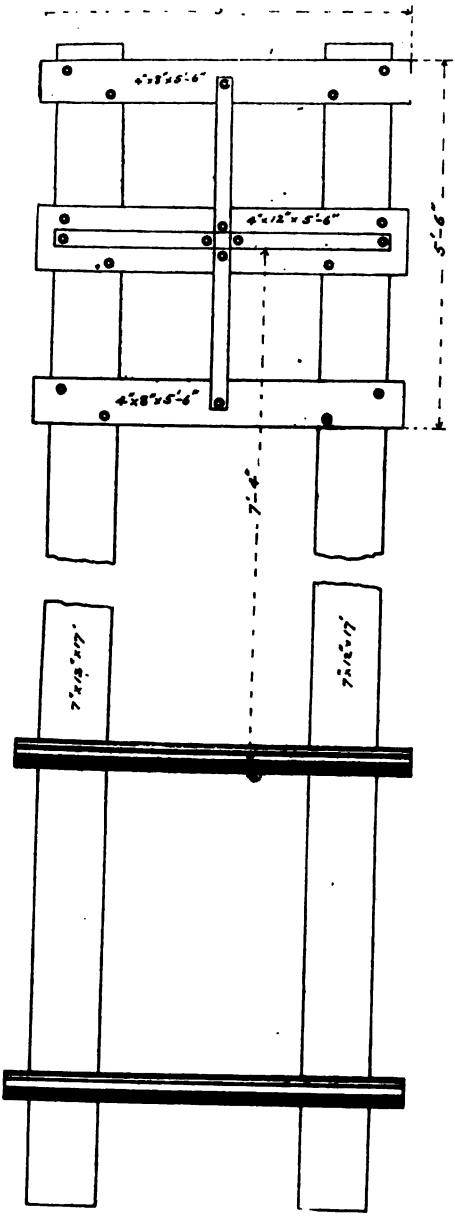


Fig. 51. Mail Crane, St. L. S. W. Ry.



PLAN

FIG. 52. Mail Crane, Chicago & Eastern Ill. R. R.

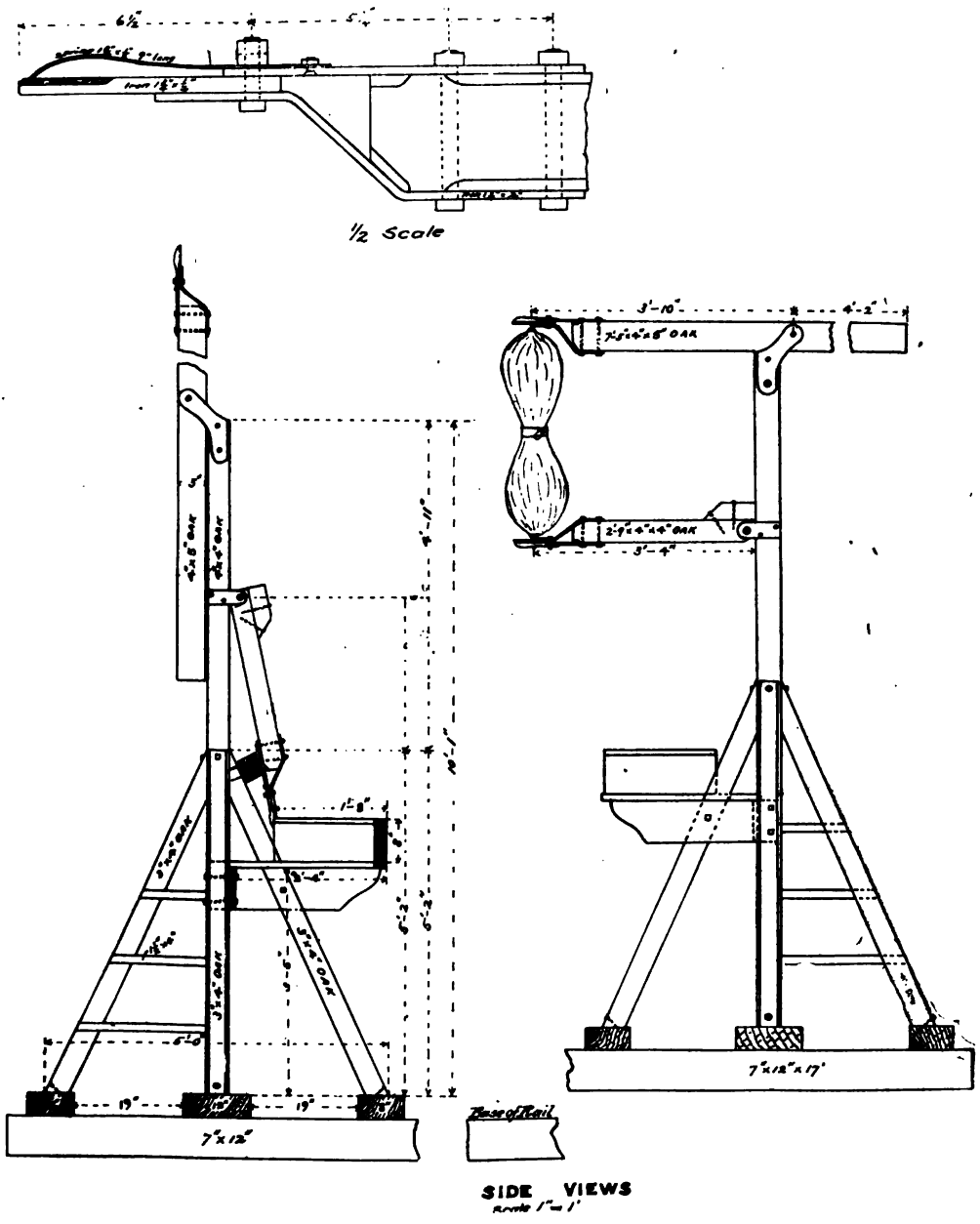
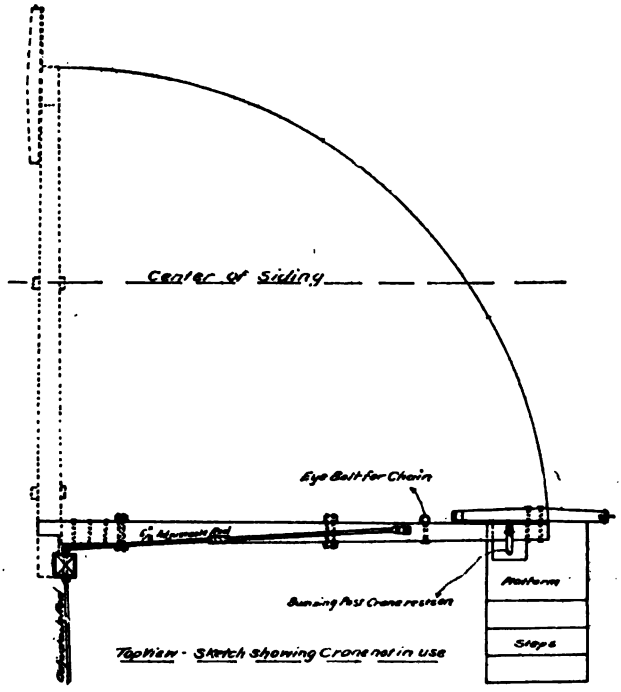
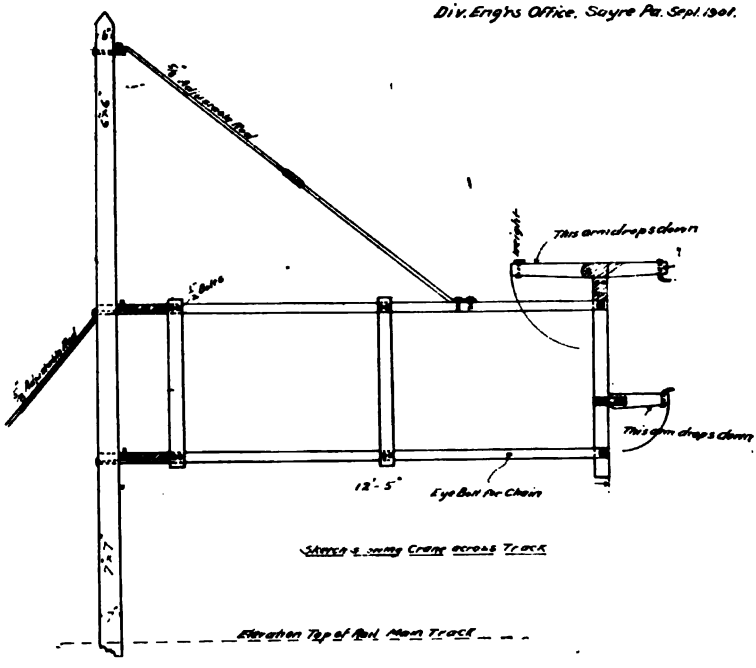


FIG. 53. Mail Crane, Chicago & Eastern Ill. R. R.



Top View - Sketch Showing Crane not in use

Plan of Swing Crane
over Side Track at Milan
Scale 1 in. = 1 ft.
Div. Engr's Office. Sayre Pa. Sept. 1901.



Sketch of Swing Crane across Track

Elevation Top of Rail Main Track

Fig. 54. Mail Crane, L. V. R. R.

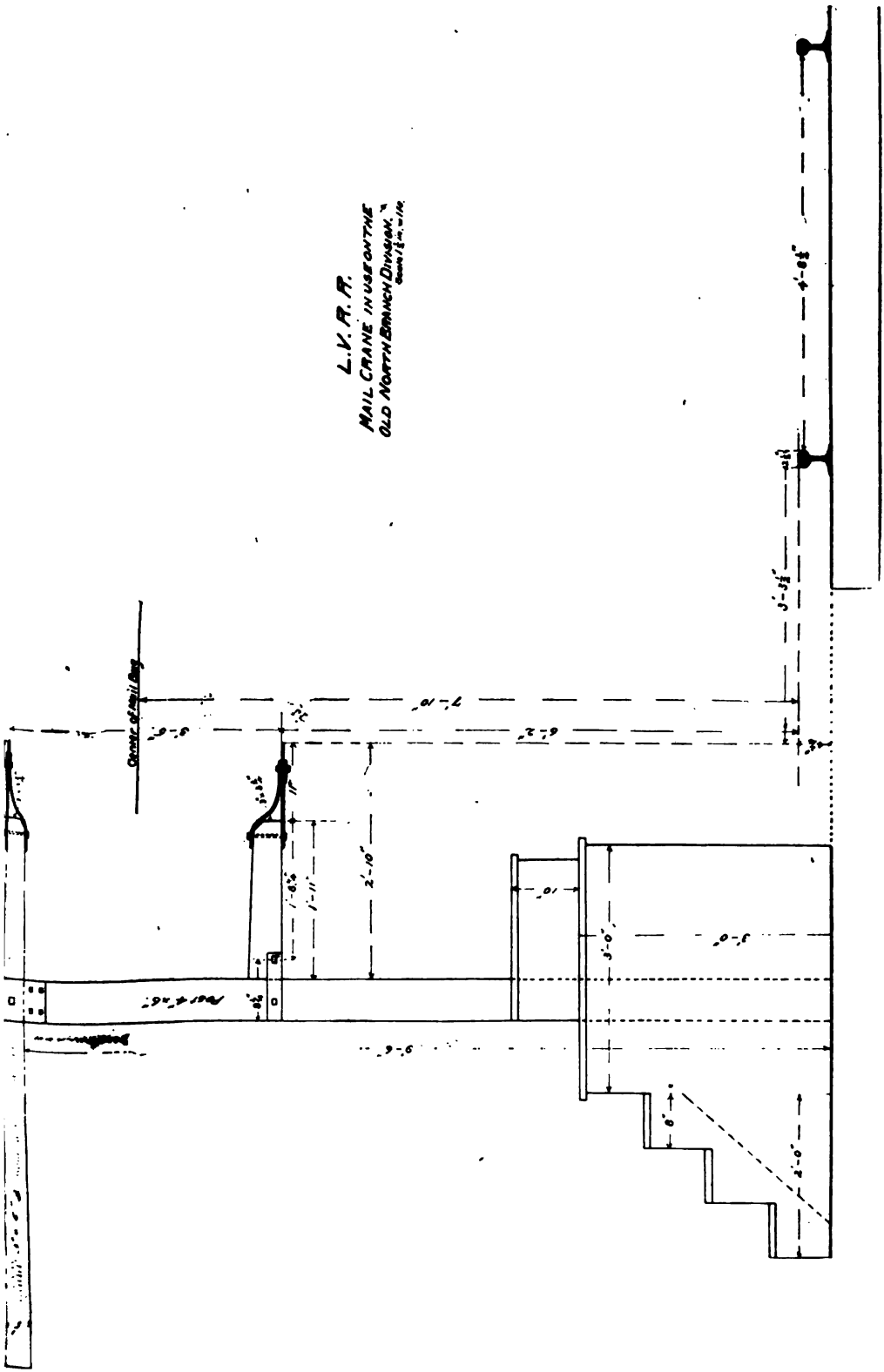


Fig. 55. Mail Crane, L. V. R. R.

LEHIGH VALLEY RAILROAD

SKETCH SHOWING

THE HAUSS IRON MAIL CRANE

AND

The Manner of Setting it

SCALE 1" = 1'

JAN 21-1901

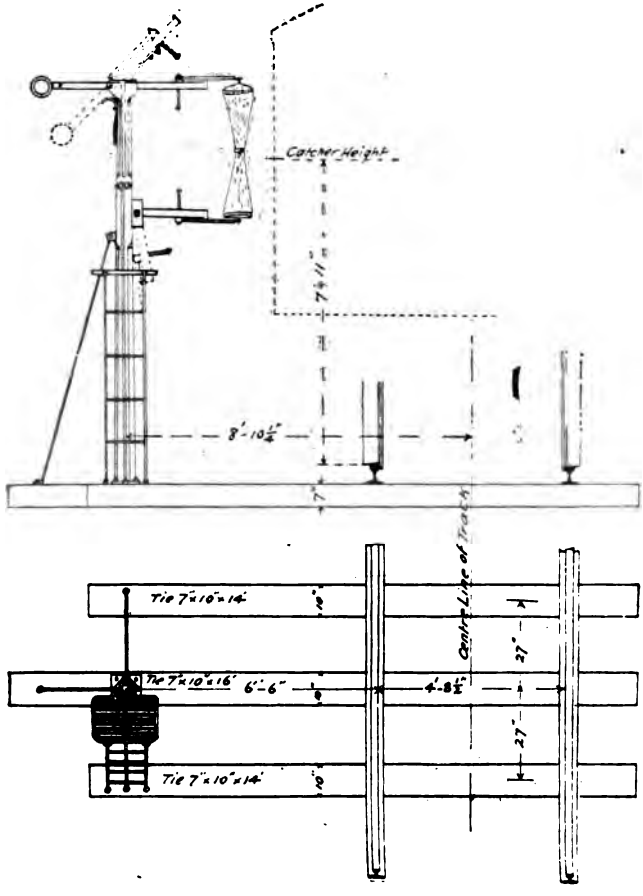


FIG. 56. Hauss Iron Mail Crane, L. V. R. R.

Fig. 57. Patent Mail Crane on P. B. & L. E. R. R.

FIG. 58. Patent Mail Crane on P. B & L. E. R. R.

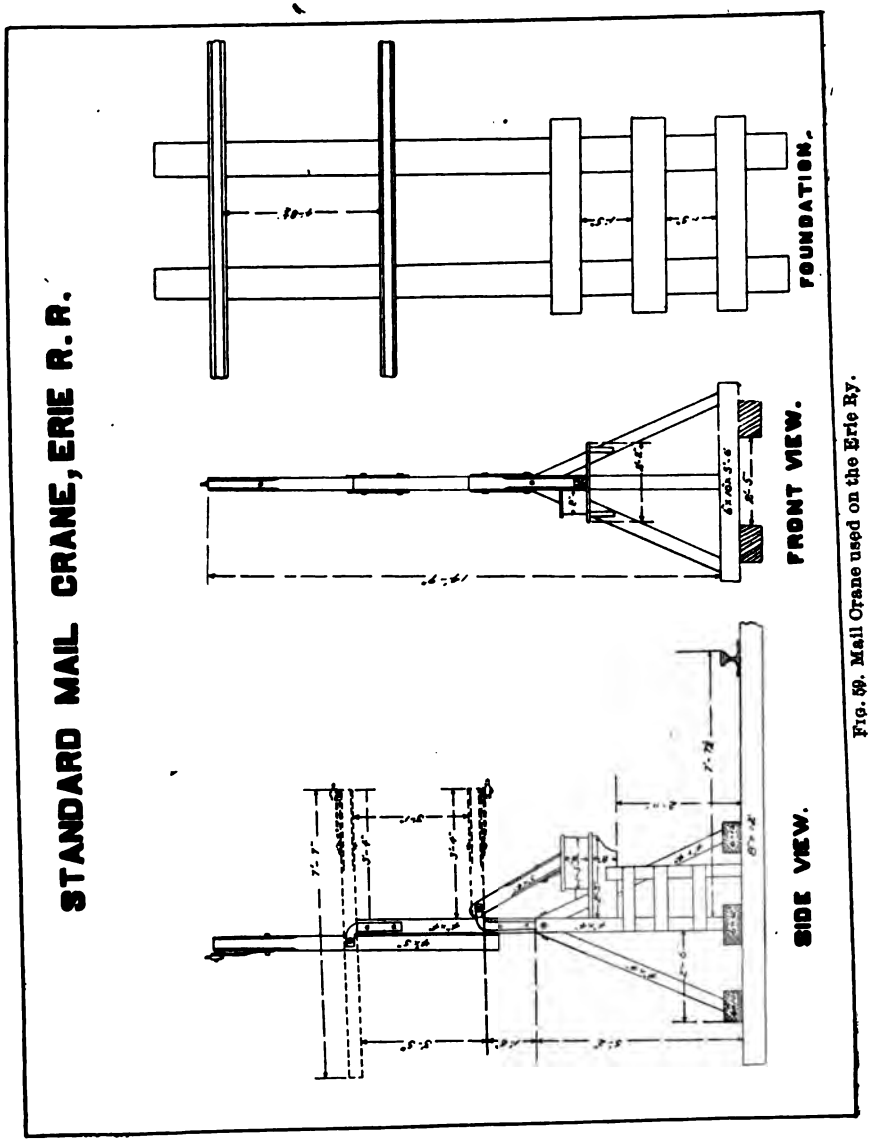


FIG. 59. Mail Crane used on the Erie Ry.

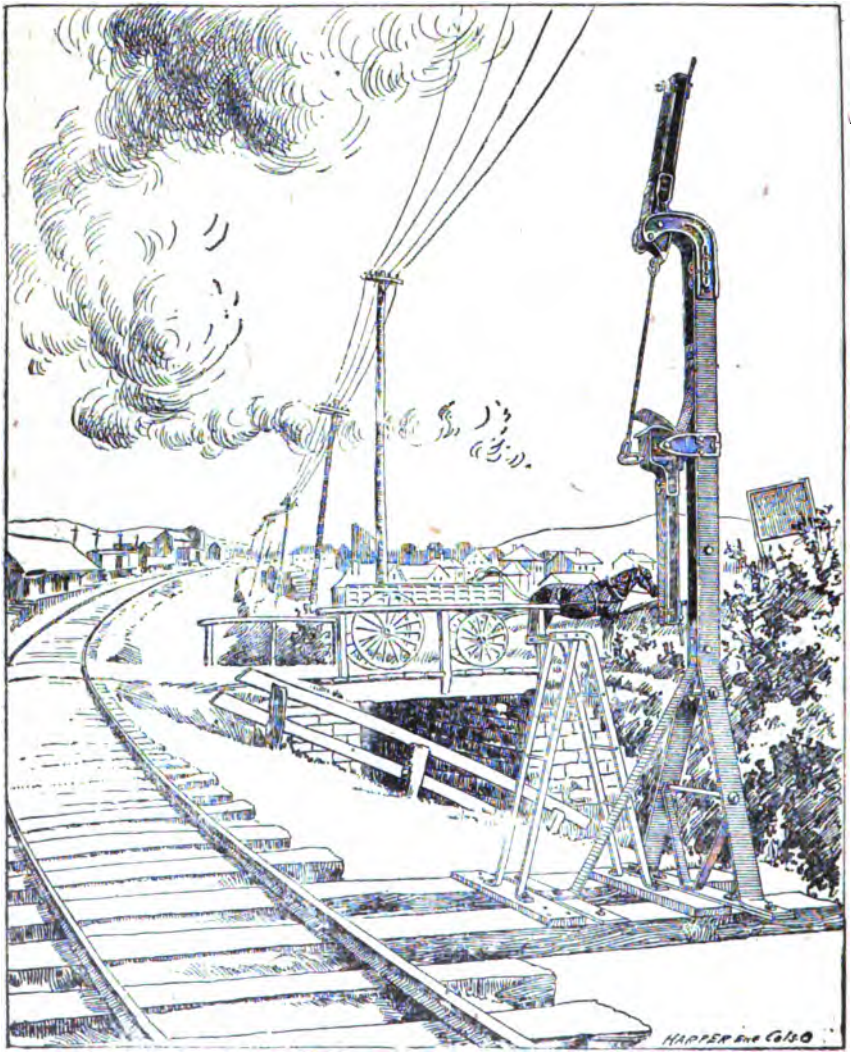


Fig. 60.—Columbian Mail Crane.

DISCUSSION.

Mr. Markley.—Mr. President, I said in the report all I had to say in reference to it; hope some or all of the members will add something more to it.

Mr. Riney.—Mr. President, I would say that the standard mail cranes used on the Chicago and Northwestern railway are shown on committee report; dimensions as follows: Box made of 2-inch by 10-inch plank, 2 feet 6 inches square filled with stone, upright 4 inches by 4 inches by 10 feet oak; cost of material for those cranes three dollars and forty cents; labor making crane, three dollars, placing, four dollars, maintaining, one dollar per year. These have given good results. While in use at all stations but three on the division, where the trains run very fast, we had so many reports of the mail being missed, we installed three of the Columbian steel mail cranes, at a cost of fourteen dollars each; labor placing each, four dollars. Occasionally we have a report which means sending a man to investigate the cause and in every case we trace the failure to the mail clerk on the car.

Mr. Reid.—The mail cranes are not in my department but we use a few of them on the Lake Shore, though I do not know the name of the crane that they use; think it is the Chamberlin crane. I believe they had some trouble about keeping the cranes in adjustment with the track but overcame that difficulty by putting all of them on long ties, that is, used long ties under the track allowing them to extend out and the cranes were bolted to those ties. Have not heard of any complaint of the cranes since they were fastened in that manner, and so far as I know they are giving good satisfaction. As to receiving the mail from the trains they simply kick it off, the same as has always been done, but there is now a patent crane being manufactured for both delivering mail to the trains and taking mail from the trains. I have never seen one in use but have seen photographs of them. I understand they have been used on the Big Four and I believe with some success, but I do not know how thorough the test has been.

Mr. Cleaveland.—I have here some photographs taken of the new mail catcher and deliverer which is patented by George R. Moore of Erie, Pennsylvania. They have installed several of these on the Bessemer roads to test them. The government is now making a test of these catchers and any one can see the construction of them by these photographs; the box of the catcher can be placed from 15 inches to 3 feet 1 inch

from the edge of the car; as to cost Mr. Moore says they can be furnished as cheap as any catcher doing the same work.

Mr. Alexander.—We have a good many mail cranes for delivering mail to the cars but we have never attempted to take the mail from the cars as the mail clerks just throw the mail off on to the platform and all we have to do is to deliver the bags to the cars, which is accomplished in about the same manner as described in the report. We have always used the long ties with the cranes bolted to them so that it makes no difference whether the place is on a curve or not, the bag will always be the same with the car, and we have no trouble with the catching of the mail bags.

Mr. Montzheimer.—I am in favor of the iron crane. There are several kinds of iron cranes shown here in the committee report and I think wooden cranes are out of date, especially those supported on posts which are affected by the frost.

Mr. Canty.—Would like to ask Mr. Montzheimer what advantage the iron has over the wooden crane. A wooden crane will last perhaps twenty years; those which we have seem to answer the purpose and take care of the mail properly.

Mr. Montzheimer.—I never saw a wooden mail crane that would last twenty years. We have some oak mail cranes, but oak soon rots, and the iron mail crane is a very little more expensive than wood. The iron crane, the one I got up, as illustrated in the committee report, is fastened as you see to long ties and gives a foundation that is always equally distant from the track, and a wooden crane, the kind we have, has a wooden box filled with stone and it is not a credit to the station grounds. Altogether we like the iron crane the best as it is neat and tasty.

Mr. Markley.—Would like to ask the cost of that iron crane?

Mr. Montzheimer. About fifteen dollars.

Mr. Canty.—We use the wooden mail crane. I have direct charge of them and have very little work on them. It is a rare occurrence when one is out of order.

Mr. Alexander—Our mail cranes are made of hard pine, and some were put in in 1894; some of these have had no repairs since except to paint, while some have needed small repairs, so they do not prove very expensive to keep in repair.

IV.—Best Design and Recent Practice in Building Railroad Track Pile Driver.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

The undersigned committee beg to submit the following report on subject No. 6—Best Design and Recent Practice in Building Railroad Track Pile Driver.

Believing that a track pile driver must still be for many years a very important item in the equipment of a large majority of the railroads of the country, and realizing that there has been less improvement along these lines than in many others, your committee have sought information from every member of this Association and also from all the prominent manufacturers of pile drivers in this country.

We find from the replies to our inquiries (extracts from which will be included in this report) that some of our members think they have found the ideal pile driver in a certain make of machine, while other members think that a machine of entirely different design is the ideal, and again we find many most excellent points, in fact, we may say some absolutely essential features for the ideal pile driver not possessed by either of these machines. We also find a very wide range of opinion as to the requirements of an ideal pile driver, but believing the ideal machine to be the one with the greatest adaptability to all of the various kinds of work required in the construction and maintenance of railroads under all the conditions to be found in our country, we would make of it the following severe requirements, all of which we do not find any one machine to possess, but which we do believe possible to combine in one, without making it unduly complicated.

1. It should be able to drive piles of any length and size from either end of car, close to the car, or fifteen feet ahead of wheel base as may be desired; either plumb or at any desired batter (within reasonable limits), and at any point of a circle the radius of which shall be equal to half the length of the car, swinging itself into the proper position for the pile by power from its own engine under the control of both the engineer and signal man at any time during the operation of raising, setting, or driving pile, without interfering with any other part of the work, being at the same time rigid enough to perfectly hold the largest pile used in the heaviest kind of permanent construction and yet sensitive enough to be susceptible of the slightest move at the will of the operator.

2. It should be rigged with a boom long and strong enough

to handle with ease and safety the heaviest bridge timber, as well as to do all of the work usually required of a steam derrick car in the erection and maintenance of bridges, culverts, etc., and should also have a capacity for heavy lifting, making it very useful in clearing up a wreck, pulling out temporary structures and old bridges, and, in fact, doing any kind of work where a strong portable steam derrick is required.

3. Its construction should be such as to make all the changes necessary to adapt it to all the various kinds of work required of it in the least possible time with a very small force of men, and so simple that no great amount of special training will be needed to fit ordinary bridge men to handle it successfully, and should not require more than six men, including engineer, for all ordinary work.

Such a machine, we believe, might easily be constructed by combining the best features of the various machines illustrated with this report, and thus secure a driver that would be able to accomplish a maximum of service at a minimum of cost, and while there may be a very wide difference of opinion expressed in the following extracts, they are mostly on details of construction rather than on the essential features of operation, and many of these may arise largely from prejudice from the use of one special type of machine, which with a larger experience might entirely disappear. Therefore, we believe that a careful study of the various drivers shown in this report, both as to construction and range of work, possible to each, will be very beneficial, and to the thoughtful man will suggest the possibility of many improvements in each type that would make it far more efficient. Let us not then rest and be content with our present achievements, but realizing that absolute perfection has not yet been attained, let us profit by the example and experience of others and seek to develop a track pile driver of such great possibilities of service and economy of operation as to win for it the most hearty approval of all practical men.

We might, perhaps, with profit, call attention to the great difference for the requirements of a machine to economically perform the work being accomplished by the B. & M. Pile Driver in building a pile bridge to replace a wrecked truss bridge in dead of winter, as shown in this report, and that for a machine to economically perform the work being accomplished by the Illinois Central Combined Derrick Car and Pile Driver, which is also shown in building false work under a through truss bridge, erecting bridges, etc. But we trust all these points will be more comprehensively covered by the discussion on this subject in convention. We will, therefore, simply add extracts from the more important of the twenty-four replies received, and with them and the accompanying cuts and descriptions of the work these machines were designed to do, together

with such specifications of construction as we have been able to secure, we most respectfully submit this report.

B. F. PICKERING,
A. W. MERRICK,
A. B. MANNING,
C. C. MALLARD,
W. M. NOON,
W. T. POWELL,
Committee.

EXTRACTS.

Mr. H. E. Eggleston, of the C., C., C. & St. Louis, thinks the Bay City, Michigan, pile driver is the ideal, but thinks it should reverse to drive from either end of car 15 feet ahead of wheel base; thinks that turning should be done by hand as engineer can keep driving while leaders are moved to suit piling; thinks it should be able to drive 10 feet from center of track; thinks leaders should be raised by steam, time, 15 to 30 seconds; should have hammer weighing 3,200 lbs. using 1¼-inch manilla rope; thinks batter of piles can best be done by swinging of leaders; thinks the ideal machine should be able to drive piling, handle all kinds of bridge timber and materials and for loading same on cars.

Mr. J. P. Snow of the B. & M. His idea of the ideal pile driver is one that can be used for all purposes of maintenance, and that can be adapted on occasion for building new work where there is no existing track; should be usable inside an ordinary through bridge; should reverse and drive from either end of car, and says that the cases where an extension driver is needed are so rare that it seems to him best to build the driver non-extensible, and have an iron out-rigger to put on in place of the regular gins with comparatively short leaders; this would leave the driver simple and rigid for regular use; thinks best method of turning driver on car by rack and pinion driven by the driver engine through the medium of a friction connection; should be able to drive 16 feet from center of track; best method of hanging leaders by hinge at top of frame with bolted connection at car body level. A rolling rocker has the advantage of compactness but its complexity outweighs the gain, he thinks; manner of raising leaders by line from engine winch head attached to lower end of leaders, time about one minute, length of leaders about 45 feet, weight of hammer 3,000 lbs. using 2-inch manilla rope; should be rigged with boom so that shift can be quickly made; thinks batter can be secured without either tilting car or swinging leaders; thinks swinging leaders not advisable; thinks the drivers of recent construction with great improvements are the Bay City, Milwaukee & St. Paul R. R., and the Northern Div., B. & M. R. R. Would suggest further improvement by removing gin pivot from the Bay City

machine and fit it and others with turning gear driven from the driver engine.

W. T. Powell, of the Colorado Southern, says ideal pile driver should be on permanent extension and able to drive 20 feet ahead of wheel base with swing leaders, and able to drive at either end of car and driver to be swung by some kind of steam power; should not be self-propelling; should be able to drive at right angles with track; leaders should be hung on an A frame so made that it can be lowered with leaders; length of leaders 40 feet; weight of hammer 3,000 pounds; two-inch manilla rope; should not be rigged with boom; 30 horse-power engine; would batter piles by swinging leaders.

Mr. M. Riney, of the C. & N. W., says ideal pile driver is one built on car, that will extend 16 feet beyond trucks, and engine swing with leads; would raise leaders by crab, one to two minutes; length of leaders 38 feet; weight of hammer 2,200 pounds; should be rigged with boom; swinging of leaders does good work in battering piling.

Mr. O. T. Nelson, of the A. W. & P. Ry., thinks the ideal driver is the Bay City machine; thinks it should be self-propelling and would be a great convenience if able to drive 15 feet ahead of wheel base from either end of car; would turn driver by cog gearing turned with a crank by hand; should drive 15 feet from center of track; leaders should be hung on pivot and raised with winch; time consumed 5 minutes; length of leaders 35 feet; weight of hammer 3,500 pounds; wire rope; should be rigged with boom; would swing leaders to batter piles.

Mr. Arthur Montzheimer, of the C. & N. W., thinks the ideal pile driver should be self propelling, be able to take a 35-foot pile under the hammer, reversible so as to drive either way, with plenty of boiler capacity; should be able to drive 16 feet ahead of wheel base; should turn with screw and cranks as on Bay City driver or by steam from driver engine; should drive 14 feet from center of track; would hang leaders on pivot similar to the C., M. and St. P. Ry. driver; would raise leaders by use of crab; time 4 minutes; length of leaders 40 feet; weight of hammer 3,000 pounds; 2 inch manilla rope; says wire does n't last well; should be rigged with boom; 24 horse-power engine; says swinging leaders not necessary to batter piles; thinks a steam hammer would be a good improvement.

Mr. N. H. LaFontaine, of the C., M. & St. P., thinks the ideal driver one that can be operated by the smallest crew and do the greatest amount of work; the application of steam or other power other than hand for all movements possible; should not run by its own power; should be able to drive 22 feet from center of track; leaders should be raised from power from its

driver engine; time 30 seconds; 42 feet leaders; 3,200 pound hammer; manilla rope, 1¼ inches; would swing leaders to secure batter of piles; thinks the best driver he has seen, that used by the C., M. & St. P. Ry., designed by C. W. & W. E. Smith; suggests for improvements pneumatic swing and movement of table on car instead of hand power as is the usual practice; would criticise recent construction as follows: lack of provision for steam or pneumatic power to supplant the old methods of hand power in operating driver.

Mr. R. J. Bruce, of the C., C.. C. & St. L. Ry., thinks ideal pile driver should be mounted with engine and boiler on frame; frame of iron except leaders, they to be 40 feet, drop hammer of 2,200 pounds; should swing leaders by steam, shift forward and back by steam; would hang leaders on hinges and so arrange that they can be tilted to batter piling; would raise leaders with line and winch, using blocks if necessary; 20 horse-power engine; would criticise usual construction by saying drivers are not generally designed to drive batter piling but are usually too light of construction and too much hand power is used.

GALLATIN, TENN., Sept. 8, 1902.

Mr. B. F. Pickering, Supt. B. & B., B. & M. Ry., Sanbornville, N. H.

DEAR SIR: I have had some 15 years' experience with pile drivers and have handled several different kinds of drivers. The best track driver I have ever seen or handled was a Bay City driver with swing leaders, and with locomotive headed on to driver, with steam connection from locomotive to driver engine, and take steam direct from locomotive to driver engine; in this case you save the cost of fireman on driver and always have plenty of steam to drive pile, and when you are using boiler on driver and you have to hit a pile 100 or 150 blows to get the proper penetration you get out of steam and have to stop and wait for fireman to get more steam, but if you are taking steam from locomotive you can just keep on driving. This driver was a friction drum and winch head, leads raised by tackle from bottom of leads to draw head in car and pull line leading to winch head; leads could be raised and lowered with locomotive running ten miles per hour. For hammer line I used 2 inch hawser laid manilla rope; pile line 1¼ inch hawser laid manilla rope. I would average about 100 piles for each hammer line. I have never seen a self-propeller driver that was a success; they are too slow and break down easily.

Yours truly,

H. M. HENSON,
Supt. B. & B.

PROVIDENCE, July 19, 1902.

Mr. B. F. Pickering, Chairman Committee Subject No. 6.

DEAR SIR: I herewith return your circular with a few notations as to what seems to me to be important. I have a pile driver which I designed and built several years ago, which has some of these features. Ours was built for a rather light class of work to be handled quickly, as at many places our time is short. We had the driver made to turn and the hoister stationary on the car. This was to enable us to drive at any point on one track without blocking the other track, where we had two tracks.

Yours truly,

J. B. SHELDON.

Mr. Sheldon thinks driver should be self-propelling for emergency; should drive from either end of car 15 feet ahead of wheel base; should drive 9 feet from center of track, for raising leaders; thinks a stop should be provided at such a point below the hinges that hammer will balance the top of leaders; time of raising and fastening 3 minutes or less; length of leaders 35 or 40 feet; weight of hammer not less than 2,000 pounds, more if driving is hard; should be rigged with boom; horse-power of engine and boiler 20.

ASHEVILLE, July 12, 1902.

Mr. B. F. Pickering, Sanbornville, N. H.

DEAR SIR: I have recently been using the Vulcan pile driver built at Chicago, and like it much better than the Bay City pile driver, on account of driving better piles. The Vulcan pile driver hammer frame works on a pivot near top of main frame, and will drive batter piles as well as plumb posts. The Bay City will swing the leads badly unless you guy it on curves where you are driving batters. The Vulcan has two hammers, or rather a follower hammer that stays with the pile, and has a jump block that top hammer strikes instead of striking the pile direct. The only trouble with this is keeping blocks; the top hammer bursts them very quickly. The jump block should be of solid rubber instead of wood, as I think it would last longer. Another matter that can be made better is the gauge frame at bottom where you throw the hammer frame out for driving batters; this should have pin holes every six inches in order to drive batters at any degree you want them. None of them will drive batters the same on a curve, as the inside of the curve will not have batter enough and the outside will have too much batter.

Yours truly,

(Signed) W. H. WOODARD,

Bridge Supervisor.

Mr. Woodard does not think that drivers should be able to reverse to drive from either end of car, but should be able to drive 15 feet ahead of wheel base from one end; should turn by gearing and level cranks; should drive 15 feet from center of track; thinks 10 minutes is plenty of time to raise leaders by leaving hammer at bottom of frame; leaders should be 36 or 40 feet; should have two hammers, one 2,200 and the other 3,600 pounds; would use ⅞ inch wire or 1¼ inch manilla rope; should be rigged with boom, 20 horse-power engine.

SALEM, July 10, 1902.

Mr. B. F. Pickering, Supt. B. & B., No. Div., Sanbornville, N. H.

DEAR SIR: Herewith I return you the circular which you sent me to fill out.

I have filled in answers to most of the questions in regard to the best design for a driver but have omitted giving any answers to the questions regarding recent practice, as I have had no experience with any driver of recent design, ours being an old driver.

I have never seen your new driver, but from what I have heard about it I should say that you have a driver about as good as one would wish; at any rate, it is the best there is on the B. & M. system, without any doubt.

I think that a driver should be as little complicated as possible, as it gets hard usage, and if it has many parts they are liable to get out of order and cause considerable trouble and delay.

Thanking you for your kind invitation to join your association, which I will consider, I am,

Very truly yours,

(Signed) WM. A. LYDSTON,
Supt. B. & B., East. Div. B. & M. R. R.

Mr. Lydston thinks the ideal driver one that does the most work with the least expense; should not be self-propelling; should be able to drive at least 15 feet ahead of wheel base from either end of car; should turn by steam power; should drive 18 feet from center of track; leaders should be raised by power from driver engine; time 3 minutes; leaders should be 42 feet long; hammer weigh 2,800 pounds; should be rigged with boom; horse-power of engine and boiler 25.

DANVILLE, ILL., July 28, 1902.

Mr. B. F. Pickering, Sanbornville, N. H.

DEAR SIR: I have your circular, together with blank form to fill out for your committee, on the best pile driver. I can only give you our experience with the driver we have been using for the past ten years.

This pile driver was built by the Industrial Works, Bay City, Mich. It would hardly be necessary for me to send a blue print of this pile driver, as I am quite sure that nearly all the members are familiar with its construction and operation. There is but one objection I have to it, and that is the direction of the pile line from the drum to top of leads; if this line were run over a sheave on the same shaft as the hammer line, it would, in my opinion, be a perfect driver, though the present mode of hoisting piles is not detrimental to the driver. As you know, this driver is self-propelling, and will run at a speed of eight to ten miles an hour and pull on a level grade five cars, and is equipped with steam brake.

The driver is equipped with engine tank similar to locomotive for hauling coal and water on one end, and pilot car on the other. Half of the pilot car is a flat car which runs under the leads when moving in train from place to place, and the other half is converted into a tool car to carry supplies for the driver, and for the engine men to sleep in. Underneath the driver on special suspended platform, pump is located and connected to boiler with suction pipe, to pump water from streams when within reach of pump into tank of driver, to avoid running to water stations for water.

The length of our leads for driver is 47 feet, the weight of hammer 2,900 pounds. We use 2 inch manilla rope. The time in raising the lead is not to exceed two minutes when everything is ready, and we can drive about 12 feet from center of main track. The size of pile driver engine is 30 horse-power, double cylinder, etc.

The engineer and fireman are the only two special men with the driver; the former we pay $2 50, and the latter $1.50, per day.

COST OF DRIVING PILES SPRING 1902.

Number of bridge.	Number of piles driven.	Length of shortest pile.	Length of longest pile.	Aggregate lineal feet piles driven.	Cost of driving.	Cost per foot of pile.
D 1094	74	14	36	1,302	$139.92	$0.107
D 1153	14	14	22	260	23.97	.092
D 1186	14	14	22	250	14 01	.056
D 1194	18	14	26	360	12.62	.035
D 1202	34	18	36	1,000	24.30	.024
D 1227	18	16	20	336	8.57	.025
D 1234	8	14	14	112	8.75	.078
D 1257	16	14	27	300	8.75	.029
D 1266	14	14	24	280	8.75	.031
D 1308	16	16	26	336	8.75	.027
D 1318	16	16	22	304	8.75	.029
D 1359	24	18	28	564	16.02	.028
D 1410	88	18	36	2,773	95.45	.034
C 1452	62	18	42	1,300	66 50	.037
D 1427	8	22	24	286	10.62	.037
D 1434	12	22	24	272	10.62	.039
Total.....	436	14	42	10,585	$466.35	.....
Average.....	27	14	42	658	20.08	$0.044

Above please find costs as they are taken from our books on driving piles with this driver, giving all the necessary information in detail. You will note in two cases the cost per foot runs 9 and 10 cents for driving. These bridges were a great distance from the side track, which accounts for the additional cost above what they would have cost had the bridges been a half or three quarters of a mile from side track; as it was they were three miles away.

We also use the pile driver for unloading material when not otherwise engaged where we have concrete or stone work to do. If the side track is very far away and the job is a large one, we put in a temporary track, and use the pile driver, under the direction of the concrete foreman, to do the unloading and loading of material, and in a great many similar cases the driver is used for purposes of this kind and certainly is a money saver to the company.

It is very rarely that we use a locomotive for handling our pile driver; of course in certain cases where the jobs are very, very short and a long way from a side track, it is advisable then to use a locomotive in order to save time. Where the jobs are very large and the side track a great distance away from where the bridge is to be driven, it is sometimes best to put in a temporary side track especially for them, to avoid using a train.

In driving piles with the driver, there is no train crew provided; our own bridge foreman gets the orders and the dispatchers in turn protect the driver between the stations where they are working against all except first-class trains. This has been our practice for the past ten years and in all that time there has not occurred a single accident to the driver by coming in conflict with trains. This practice has saved the company considerable money.

The point has been raised several times that a train crew or a conductor, at least, should be sent to look out for the driver and to see that it was kept out of the way of the regular trains. The argument raised by the transportation department that bridge foremen were not competent to handle pile drivers on the main track, was always met by the argument that if a bridge foreman is competent to tear out a bridge, thus making it possible to ditch an entire train, he was certainly competent to handle a pile driver on main track driving piles, which is true in every particular. Of course flagmen are always out when the driver is on the main track, this in addition to protection given by train dispatchers.

It is often the case when train men are used to handle work trains and trains of similar nature, they as a rule are figuring on when they can go to side track and just how long they can lie there and not be criticised by their superior officers, thus delaying the work unnecessarily. This can be overcome by a good bridge foreman who will watch closely and keep the work

going. We do not confine ourselves to one particular foreman; each foreman does his own work on his own division. We are charged $2.10 per hour for a train and crew.

Yours truly,

(Signed) A. S. MARKLEY, *Supt. B. & B.*

CHICAGO, ILL., July 18, 1902.

Mr. B. F. Pickering, Sanbornville, N. H.

DEAR SIR: I am returning you herewith your committee's circular regarding pile drivers. I have made brief answers in the blanks provided, but on account of their brevity some of them may not be understood.

In my specification for ideal pile driver, I state (1) self-contained. By this phrase I mean a machine which can perform all its operations and can adapt itself to the varying conditions which develop during the progress of its operation without connection with outside fixed objects. For instance, I think the raising and lowering of the leaders, the swinging of the leaders laterally to the point where the pile is located, the projection of the deck forward to the requisite distance ahead of the front car wheels, the swinging of the deck and the forward and back motion necessary to adapt the location of the leaders to the pile as it is being driven, should all be performed by men on the car through devices which are a part of the rig. I mean, this is opposition to leaders which require a line and shears with a hitch to the track when being raised and lowered, and to cars which have to be pinched back and forth to adapt the location of the leaders to the location of the pile as it is being driven, and to drivers so built that in order to get the necessary projection ahead of the front car wheels the truck has to be set back or the deck transferred to a point further ahead on the car. The phrase "self-contained," as used by me, also implies that when the deck is swung at right angles with the car, a pile can be driven without tipping the car over and without having guys to prevent this result.

Under the question regarding method of hanging leaders, I mention the fact that when leaders are hung on a trunion so they can swing to a batter the driver can be used for driving falsework piles under truss bridges. This may not be clear without further explanation, and so I call your attention to the usual pile driver with fixed leaders. It is evident that such a deck cannot be swung out far enough to drive a pile close to the bottom chord of truss, because the deck will foul the web members of the truss and the center line of pile in the leaders would not be 3 feet from the center line of the track. When the deck is in that position, if the leaders are suspended on a trunion or a pin, about 25 feet from top of rail, the bottom end of the leaders could be swung out so that the pile hung in the leaders would pass close to the bottom chord of the truss.

After being driven the pile can be cut off and with very little force sprung to a position immediately under the truss. Where the usual length of leaders is used this necessitates the removal of a portion of the top lateral system, but this is not a serious feature as compared with the necessity of having a special pile driver for such emergencies.

When I mention the use of a hoist engine in connection with the manner of raising leaders it is not that I like a rig which requires that amount of power, but that the engine is the most convenient source from which to obtain the small amount of power needed to operate the leaders.

The time specified, two minutes, ought to include all the preliminary operations preparatory to raising the leaders; if the leaders are properly balanced and the connections are simple it will not take more than 30 seconds from the time the signal is given to the engineer till the leaders are in vertical position ready for the operation of the hammer.

Yours truly,

G. W. Smith.

Mr. Smith thinks it would be convenient to have driver self-propelling but not essential, but quite essential that it should be able to drive from either end of car and 18 feet ahead of wheel base; should be able to drive at right angles to car without guys; leaders should be hung on trunion so they can swing to drive piles on a batter if necessary; this also permits use for false-work piles under truss bridges; would raise leaders by power of driver engine; time two minutes from issuing order till completion of operation; length of leaders forty feet and extras of less length if desirable; weight of hammer 3,000 pounds; 1¼-inch tallow laid manilla rope; thinks wire may be preferable but has never used it; thinks very decidedly that driver should be rigged with boom; horse-power of engine 20 to 25; thinks C., M. & St. P. Ry. Co. is best recent design he knows.

Mr. W. E. Smith, of the C., M. & St. P., thinks the ideal driver is one that can drive a long distance ahead of wheel base, say not less than 16 feet, and from either end of car and a long distance from centre of track without other support than track rails, say not less than 23 feet; one whose leaders do not project past either end of its car and can be coupled in between any kind of cars without a special drawbar; one whose leaders can be raised and lowered in less than one minute and can be raised or lowered while the car is in motion, therefore, no loss of time; one whose deck is as clear and roomy to work on as a deck of a boat and has the least possible obstruction to the engineer's view of what is going on at the whole length of the leaders; one whose deck can be run forward for driving ahead either by hand or power easily and quickly; should be self-propelling, should swing by means of a circular rack or gear under the

middle of the deck, and of as large diameter as width of car will permit and in combination with a circular track and rollers in same place; leaders should be hung on a pivot high up so that in getting a desired batter on outside piles the foot of leaders would extend well out without swinging deck, which latter cannot be done when driving false work under through spans; length of leaders 40 feet, weight of hammer not less than 3,000 pounds, 1¼ or 1¼-inch best manilla rope; should most certainly be rigged with boom to use as track derrick; horse-power of engine and boiler not less than 20; does not know any driver that has all the good points he could suggest; thinks the driver used by the C., M. & St. P. Ry., illustrated in this report, the nearest to being all right of any he knows; says in line of improvement, many drivers have too much rigging on their decks or have no decks or place for men to work on without hanging on with both legs and one arm while they work with the other arm, like a man in the rigging of a ship, and so much obstruction to the engineer's view that there are constant petty delays, and constant danger of accidents by misunderstanding signals.

The C., M. & St. P. pile driver X-218, designed by Mr. W. E. Smith, cuts of which appear herewith, is thus described by Mr. Smith:

In designing the C., M. & St. P. Ry. pile driver X-218, it was desired to construct a machine that would serve for all the purposes which have been outlined above without sacrificing simplicity of construction. The car is 45 feet long and is equipped with air-brakes and M. C. B. standard couplers. In order to avoid extreme height of driving deck the car was made as low as is consistent with good construction, the height from top of rail to top of sills being 3 feet 5½ inches. Two extra truss rods are placed under the car to prevent sagging, and the transoms of the Barber truck are extended so that they come under the outer sill of the car body. Riveted to the top of the transom is a heavy plate carrying a jack screw, which can be turned up against the car sill, thus preventing any side tip which the car springs would permit. These jacks are not needed except when the leaders are swung a considerable distance from the centre of the track. The driving deck is the same length as the car, and when the leaders are lowered they do not project beyond the end of the car. This construction permits the pile driver to be coupled in a train with any sort of a car that may happen to come next to it, regardless of the height of the latter. The highest point of the pile driver itself when ready for the road is 16 feet 8 inches above the top of the rail. The smoke-stack shown on the plate is so arranged that it can be let down when not in use.

The first step toward preparing the driver for service is to move the driving deck ahead so that when the leaders are in an upright position they will not interfere with the coupler on the

end of the car. This movement of the deck is accomplished by operating the capstan near the front. The motion is transmitted through a sprocket chain between the two centre sills of the deck, to a sheave at the centre of the deck, which operates a vertical shaft on which is a pinion which engages a rack along the side of one of the centre car sills. The movement forward and back is permitted by the intermediate deck on which is carried the centre on which the driver swings, and the circular racks by which the swinging is accomplished. This intermediate deck is built of 5-inch channels, between which are located a number of 5-inch wheels which travel on 1-inch plates secured to the top of the car sills.

The construction which accomplishes the raising and lowering of the leaders is unique, and, so far as the writer knows, is not to be found on any other pile driver. By reference to cuts a pair of rockers will be seen, the outline of which is a quadrant of a circle. The lower end of each rocker is at the deck, and the circumference passes forward and upward toward the leaders. These rockers are a part of the framework to which the leaders are secured, and as they pass gradually from a horizontal to a vertical position, the rockers continue to rest on the deck, the point of contact passing to the front until the leaders are in an upright position. The cuts show the details of the rocker arrangement and framework supporting the leaders very plainly.

The leaders are supported at a point 20 feet above the deck, which is at the apex of a four-cornered tower. The two legs of this tower, on the side nearest the observer, consist of a pair of angles over the front corner of the deck, and a diagonal ladder behind, and are matched on the further side by two members which serve the same purpose, although the rear one is not a ladder. The fixed portion of this tower is the "A" bent in front, the rockers with their radial struts, the platform 7 feet above the deck, and two rear braces from this platform up to the apex of the tower. That portion of the rear braces which extends from the platform down to the deck is hinged and jointed to permit the rocker to roll back when the leaders are to be lowered. The connection at the platform and at the deck is a plain pin. The connection at the middle has two pins, only one of which is removed when the leaders are to be lowered. The result is that this portion of the rear brace folds up like a jackknife, but at no time is the tie between the apex of the tower and the deck of the driver entirely broken. This prevents any chance that the leaders, with the framework attached, might go clear off the end of the driver if carelessly raised.

The tread for the rocker is a "T" shape, with the head laid on the deck. The rocker itself consists of two plates with a filler between, one plate riding on each side of the upright leg of the "T." Round notches in the rocker to match pins in the tread prevent the former from getting out of place in operation.

This method of raising and lowering the leaders is remarkably satisfactory, because with the hammer properly located in the leaders, they are so nicely balanced that with the use of very little power they can be started from either the horizontal or vertical position, and once started they will continue their motion, reaching the opposite position without jar. The rocker instead of being a true circle is lightly flattened, with the result that if the leaders were left to assume a normal position they would remain on an incline. Therefore, when they are started either down or up it is necessary to give them a sufficient motion so that the momentum will just carry them to their proper position. When the leaders are lowered, the hammer is drawn up until it comes opposite the platform, and is thus given support because the platform at that time has its lower edge resting on the deck.

The points of great value accomplished by this design are that the leaders are so nicely balanced that they can be raised and lowered without making any outside hitches, and when lowered they are so far back on the car that the ends do not overhang, and thus prevent coupling with box cars. Almost all forms of pile driver, in order to permit shipment, require either a flat car coupled on in front or a long bar to reach from the pile-driver coupler to the coupler of the next car. In fact, the majority of pile drivers require the latter even when coupled on to a flat car. This long bar is a very unsafe contrivance, in case of sudden shock, and couplings cannot be made with safety to the brakeman. If the bar should fail to enter the coupler, the approaching car would certainly catch the brakeman between it and the pile driver. Many accidents have occurred through the use of the long coupling bar, and the design of pile driver X-218 is very satisfactory for that reason in particular.

For extension work the deck of this pile driver can be moved forward until the centre of the leaders is 18 feet beyond the centre of the front car wheels. The process by which this is accomplished has already been explained. The swinging of the deck is accomplished by operating pinions, which engage the circular racks attached to this intermediate deck. There is one short section of circular rack at each end of the intermediate deck, and at the centre is a complete circle, by which the deck can be swung clear around. So long as the ends are over this intermediate deck they are partly supported and enabled to move freely by rollers, but after swinging clear of these the deck is balanced by the proper arrangement of the load. The pinions for swinging the deck are operated by rachet levers.

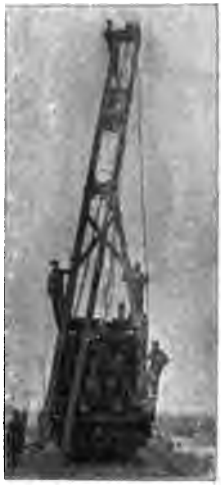


FIG. 61. Driving Batter Piles, C., M. & St. P. Ry.

FIG. 62. Driving Piles along side of Track, C., M. & St. P. Ry.

FIG. 63. Pile Driver Arranged for Transportation, C., M. & St. P. Ry.

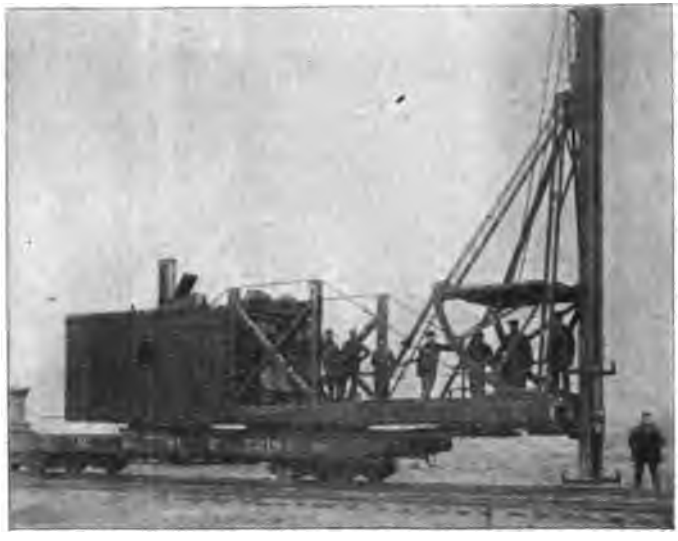
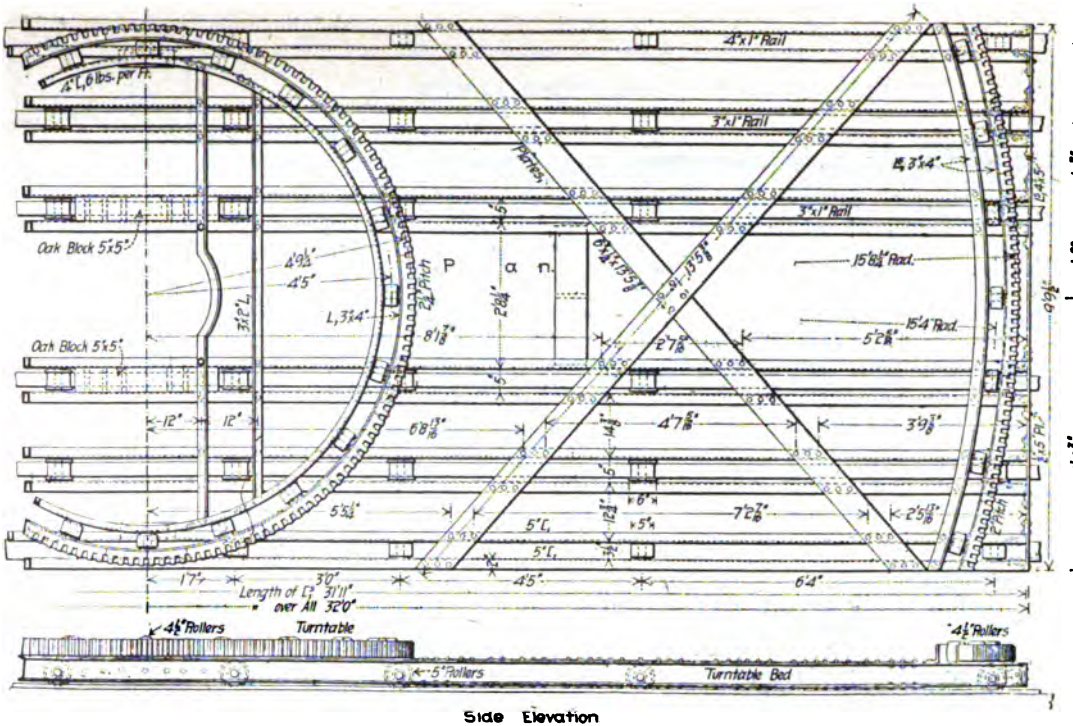
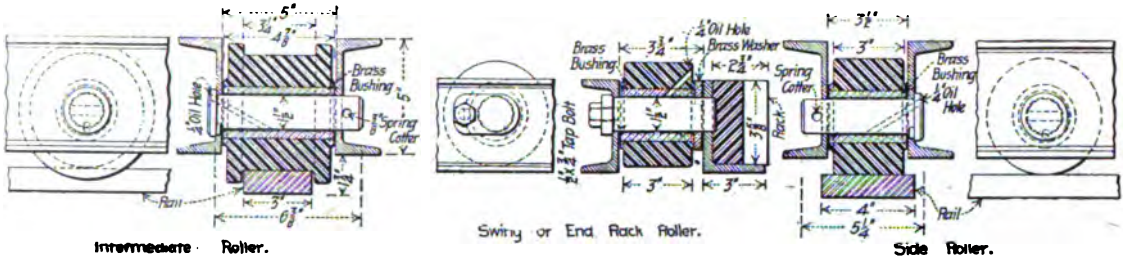


FIG. 64. Railway Track Pile Driver, C., M. & St. P. Ry. Driving Piles in Advance.



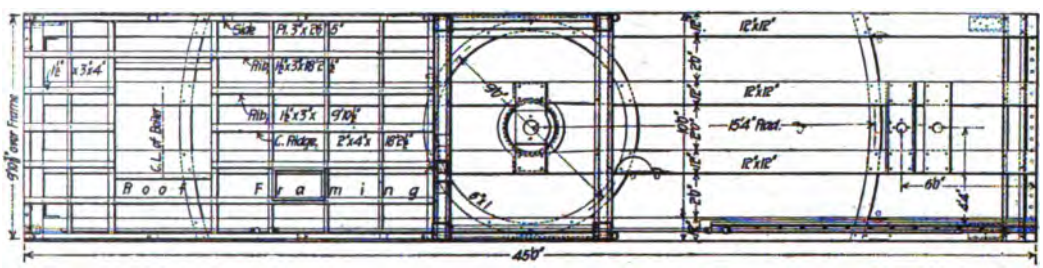
PLAN OF TURNTABLE BED AND ROLLER TRACKS.

Fig. 65. Details of Pile Driver Car, C., M. & St. P. Ry.



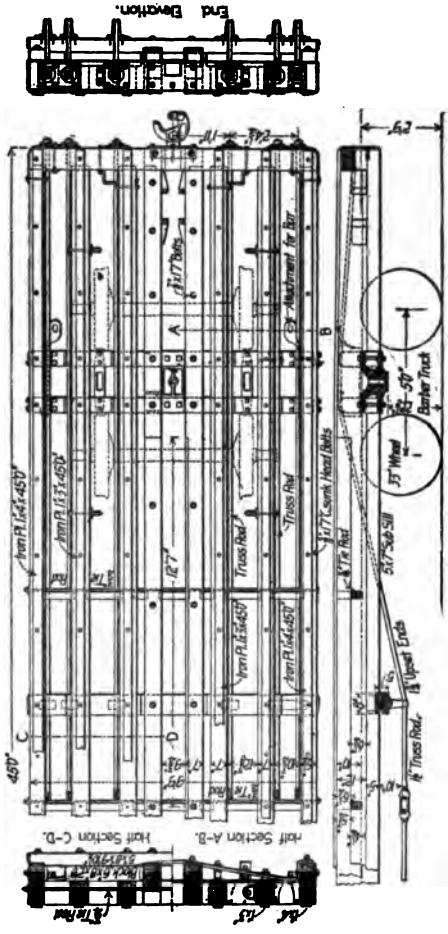
DETAILS OF TRAVELING AND SWINGING ROLLERS.

FIG. 66. Details of Pile Driver Car, C., M. & St. P. Ry.



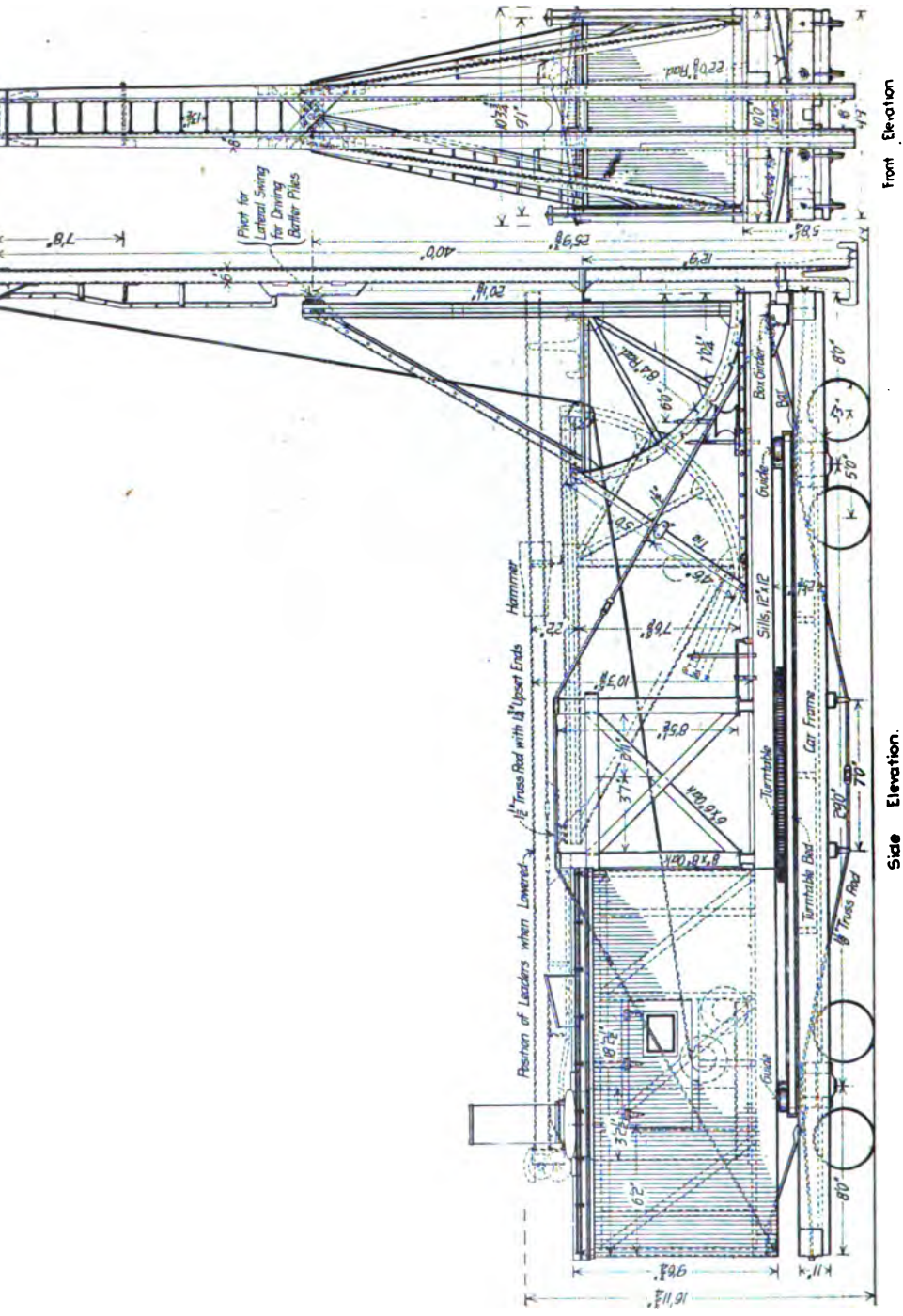
PLAN OF ENGINE BED OR UPPER DECK FRAMING.

FIG. 67. Details of Pile Driver Car, C., M. & St. P. Ry.



PLAN AND SECTIONS SHOWING CAR FRAMING.

Fig. 68. Details of Pile Driver Car, C., M. & St. P. Ry.



SIDE ELEVATION.

FIG. 69. Pile Driver, C., M. & St. P. Ry.

Combined Derrick Car and Pile Driver, Illinois Central Railroad, designed by Mr. O. J. Travis, superintendent of bridges. This type of machine has been used principally for the erection of steel and iron bridges, and has a lifting capacity of 30 tons. Steel plate girders of large pattern are handled with the derrick, in setting out ahead, with rapidity and safety. The derrick is also used for erecting truss spans up to 150 feet in length, without the use of a traveler. Mr. Travis informs us that this method of bridge erection has been employed under his supervision quite frequently during the last five years, travelers being used only on exceedingly long spans. A rough sketch of the machine is shown in Fig. 70. As this sketch was not copied from a working drawing it is not to scale, and but few dimensions are given. There is a heavy A-frame, with a boom made from a 12x12-inch timber, 27 feet long. The pile-driver leads are hinged at the end of this boom, and to steady them at the bottom there is an extension strut, which can be run forward by means of a hand wheel and rack. In some of the machines, however, this feature takes the form of a telescoping pipe, which can be adjusted to the requirements imposed by the angle of the boom. This pipe is hinged at the foot of the boom, and in swinging the boom to the side of the track the adjustment of this extension brace is not altered. There is also a pair of 9-inch I-beams reposing in guides along the side sills of the car. These I-beams are connected by a cross beam at the front end, and can be run forward by means of a crank and cog rack. A half-tone reproduction from a photograph of the machine appears in Fig. 71, without, however, the extension beams referred to. The pile-driver leads range from 18 to 24 feet in length. These leads are formed by 4x6-inch angles riveted back to back.

Bridge men engaged in the erection of steel bridges appreciate what a convenience it is to get a pile driver inside of a through-truss span to drive false work for the renewal of the structure. With this machine the work is reduced to a simple matter, as no lateral or other braces have to be removed. The boom of the machine is simply lowered; the machine enters the bridge and can be set to work in a few minutes. Fig. 72 shows work of this character in progress. Fig. 73 shows the machine in the act of lifting a long pile with the pile line. The advantage of being able to raise the boom to increase the height of the pile-driver leads is apparent. In addition to the use of the machine for bridge erection and pile driving purposes, it has also been found an excellent wrecking derrick. On numerous occasions the transportation department has sent for the machine, to be handled by experienced bridge men in clearing up wrecks.

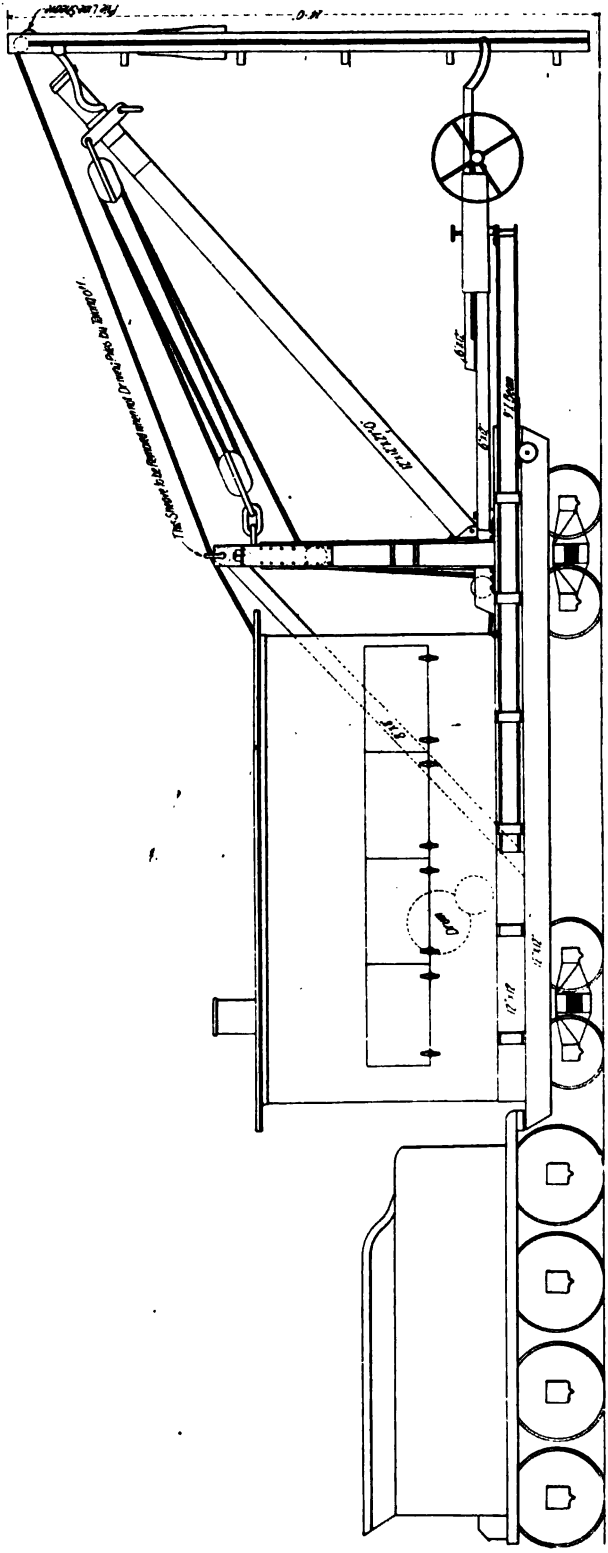


Fig. 70. Combined Pile Driver and Derrick Car, Ill. Cent. R. R.

Fig. 71. Combined Pile Driver and Derrick Car, Ill. Cent. R. R.

FIG. 72. Combined Pile Driver and Derrick Car, Ill. Cent. R. R.

FIG. 73. Combined Pile Driver and Derrick Car, Ill. Cent. R. R.

Pile Driver No. 3514, *Boston & Maine Railroad*, was built on ideas worked out by Mr. B. F. Pickering, supervisor of bridges and buildings, Sanbornville, N. H. The pile-driver car is 40 feet long by 9 feet wide. The car body is made up with two 10x12-inch side sills, two 8x10-inch centre sills, and four intermediate sills, 8x8 and 6x8 inches, all except the side sills being reinforced with 6-inch channels bolted to the sides. Four of these channels are allowed to project 2 inches above the top line of the other sills, to serve as guides for the extension deck, on which the superstructure rests. The four centre sills are plated on top with ¼x6-inch iron. There are six 1¼-inch truss rods with upset ends. The car is mounted upon diamond-frame trucks, the bolsters of which are allowed to extend the full width of the car, being provided with nuts in their ends and 3-inch screws for adjusting the car to any level. The car is fully equipped with air brakes.

The car body proper is not planked over, the planking being on the extension deck, which is composed of sills 6 inches in depth and of a width to correspond to that of the sills of the car, having two cross beams bolted to the top of the sills, each 5½ feet from the centre, carrying screws to raise the extension deck on two steel rollers which run on the plated sills. This deck can be easily moved in either direction to bring the centre of the leaders 18 feet ahead of the forward wheel base. This arrangement is convenient for driving new work, or in case of washouts. By releasing the screws the deck can be made to rest upon the car sills, thereby increasing the rigidity of the driver when in service. The change involved in this operation consumes only five minutes of time.

The accompanying illustrations show the construction of the pile driver. The leaders are of white oak, 41 feet long under the head, reinforced with 7-inch, 17-pound steel channels. The leaders are 22½ inches apart. The hammer weighs 2,800 pounds, and the engine is a Lidgerwood machine of No. 71 type. A leading feature of the design of this pile driver is that the turning is done entirely by engine power, thus saving the labor of two to four men and accomplishing the work in a more satisfactory manner than when done by hand. The turning movement is under the control of either the engineer or the signal man at all times, without stopping the hammer, which renders it possible to drive piles at any point within a circle of 45 feet in diameter without moving the car. The driving apparatus operates equally well from either end of the car, and only four minutes' time is required to reverse from one end of the car to the other. This movement is accomplished by means of a circular rack, 9 feet 4 inches in diameter, bolted securely to the centre circle rail, in which runs a pinion operated by worm gear, which, in turn, is driven by friction cones on the lower drum shaft of the engine.

The manipulation is by means of an operating lever in the

engine room and on the forward end of the driver frame. By this manner of turning greater power and also greater speed is obtained than by hand turning. As the worm gear holds rigidly wherever it is left this arrangement allows the signal man to easily make all the lateral changes necessary while driving a pile without stopping the hammer. To drive piles at a batter the car is tilted by means of the screws in the end of the truck bolster, a few turns being all that is necessary to secure the desired batter. These screws also serve as extra side bearings when the driver is being used as a steam derrick.

For lifting purposes the driver is equipped with a boom, making the machine a convenient derrick. To increase the stability of the car when used for such purposes there are eight rail clamps and stiff legs. We understand that the machine has repeatedly handled objects weighing from 10,000 to 20,000 pounds, 32 feet from the center of the track, without difficulty. For wrecking purposes the car is equipped with a shorter boom, by means of which objects can be lifted weighing about double the above figures. When used as a derrick the frame of the driver is securely clamped to the car. Another advantage in the way of stability when being used as a derrick is the heavy construction, the machine complete weighing 100,500 pounds. The height of the machine folded for shipment is 14½ feet.

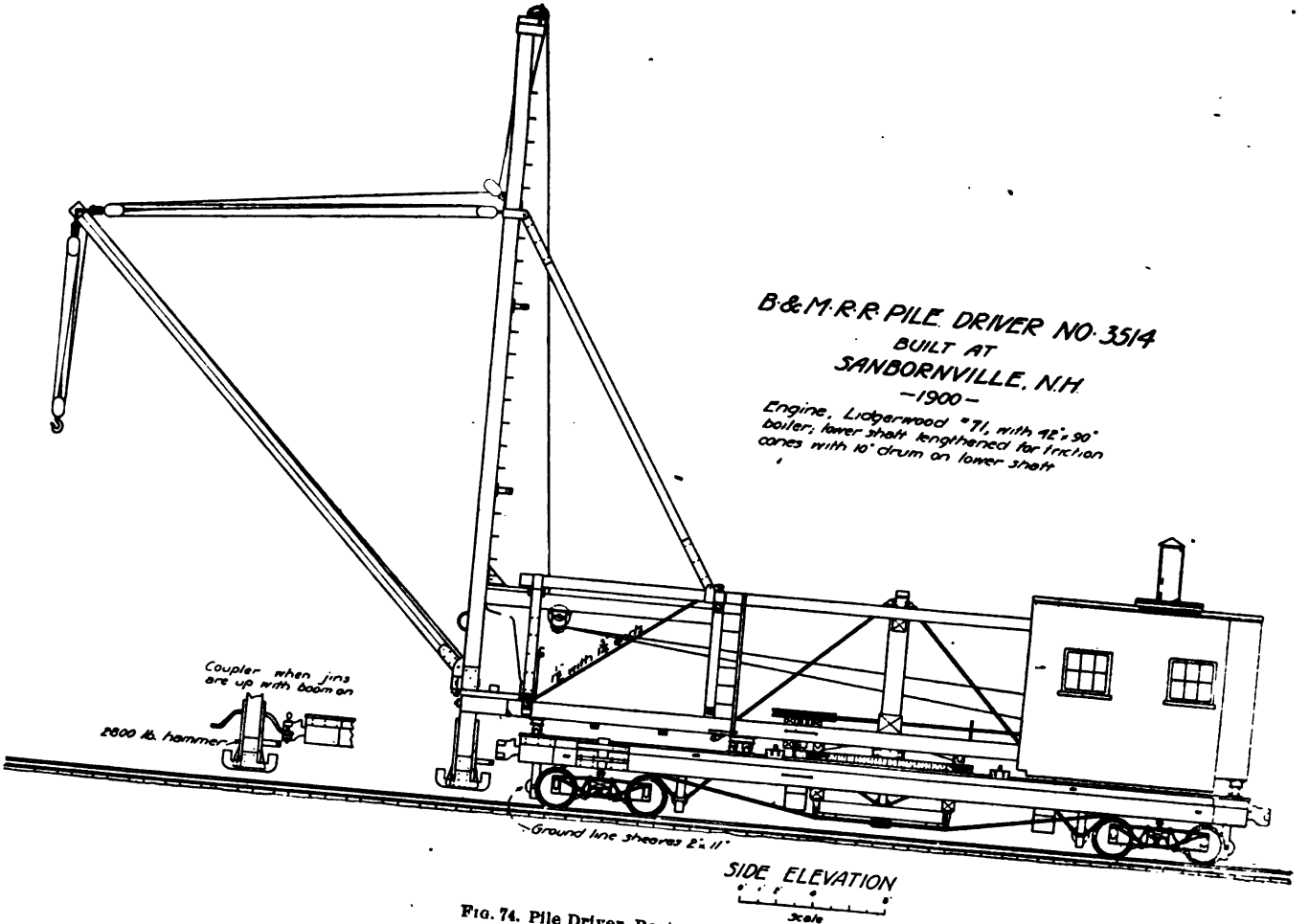
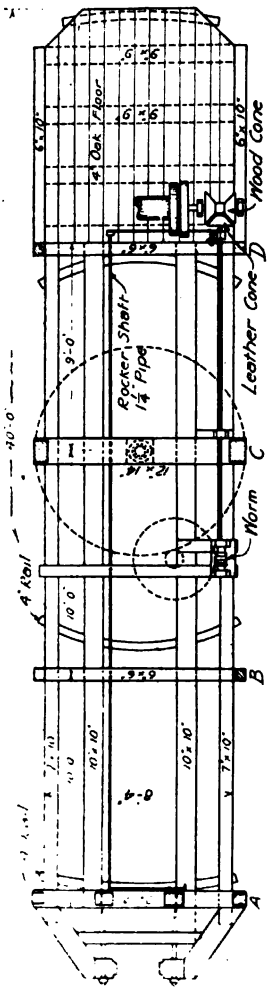
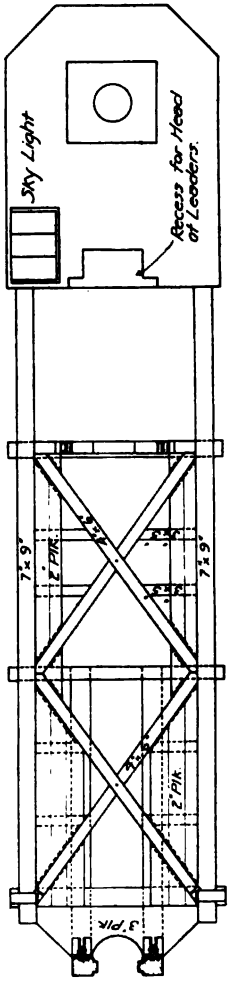

B & M R.R. PILE DRIVER NO. 3514
BUILT AT
SANBORNVILLE, N.H
-1900-
Engine, Lidgerwood "71, with 92" x 90" boiler; lower shaft lengthened for friction cones with 10" drum on lower shaft
Coupler when jibs are up with boom on
2800 lb. hammer
Ground line sheaves 2'-11"
SIDE ELEVATION
Scale

FIG. 74. Pile Driver, Boston & Maine R. R.



PLAN OF BOTTOM OF DRIVER FRAME.

Scale.



PLAN OF TOP OF DRIVER FRAME.

FIG. 75. Details of Pile Driver Car, Boston & Maine R. R.

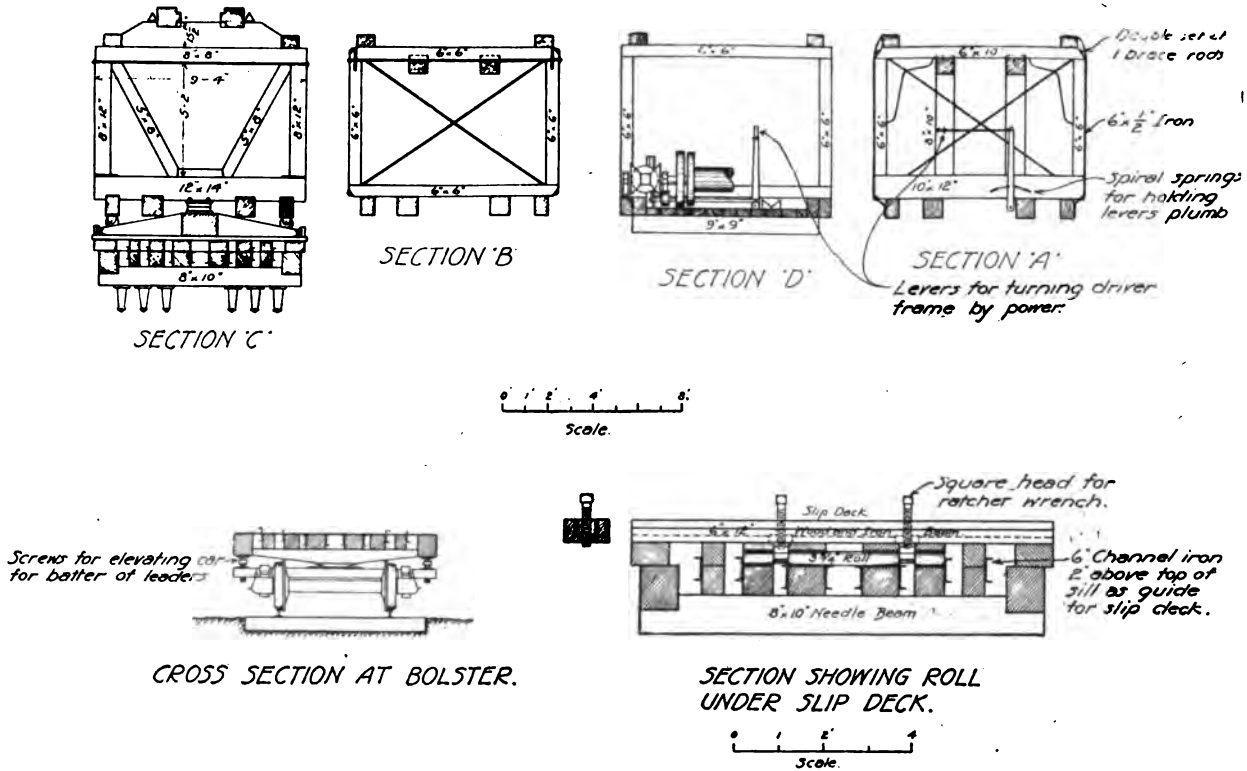
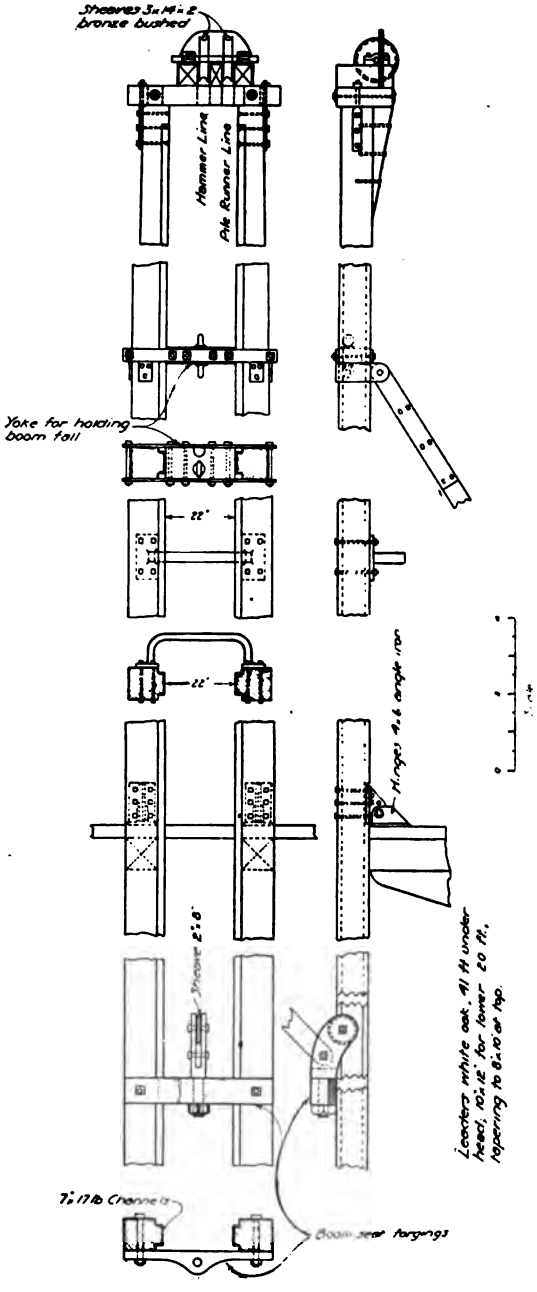
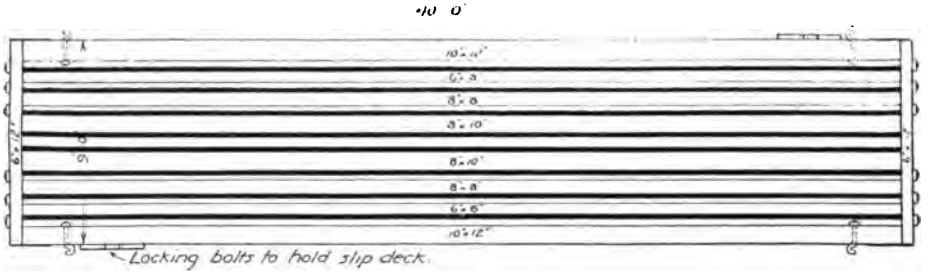

SECTION 'C'
SECTION 'B'
SECTION 'D'
SECTION 'A'
Double set of 1 brace rods
6"x1/2" Iron
Spiral springs for holding levers plumb
Levers for turning driver frame by power.
Scale.
Screws for elevating car for batter of leaders
CROSS SECTION AT BOLSTER.
Square head for ratcher wrench.
Slip Deck.
3¼" Roll
6" Channel iron 2" above top of sill as guide for slip deck.
8"x10" Needle Beam
SECTION SHOWING ROLL UNDER SLIP DECK.
Scale.

FIG. 76. Details of Pile Driver Car, Boston & Maine R. R.



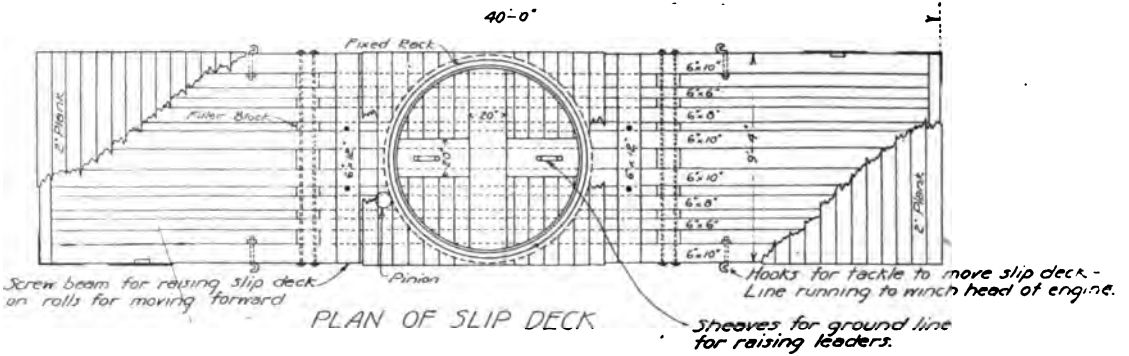
FITTINGS ON LEADERS

Fig. 77. Details of Pile Driver Car, Boston & Maine R. R



PLAN OF SILLS OF MAIN CAR.

Scale.


40'-0"
Fixed Rack
Filler Block
2" Plank
Screw beam for raising slip deck on rolls for moving forward
Pinion
Hooks for tackle to move slip deck - Line running to winch head of engine.
Sheaves for ground line for raising leaders.

PLAN OF SLIP DECK

Fig. 78. Details of Pile Driver Car, Boston & Maine R. R.

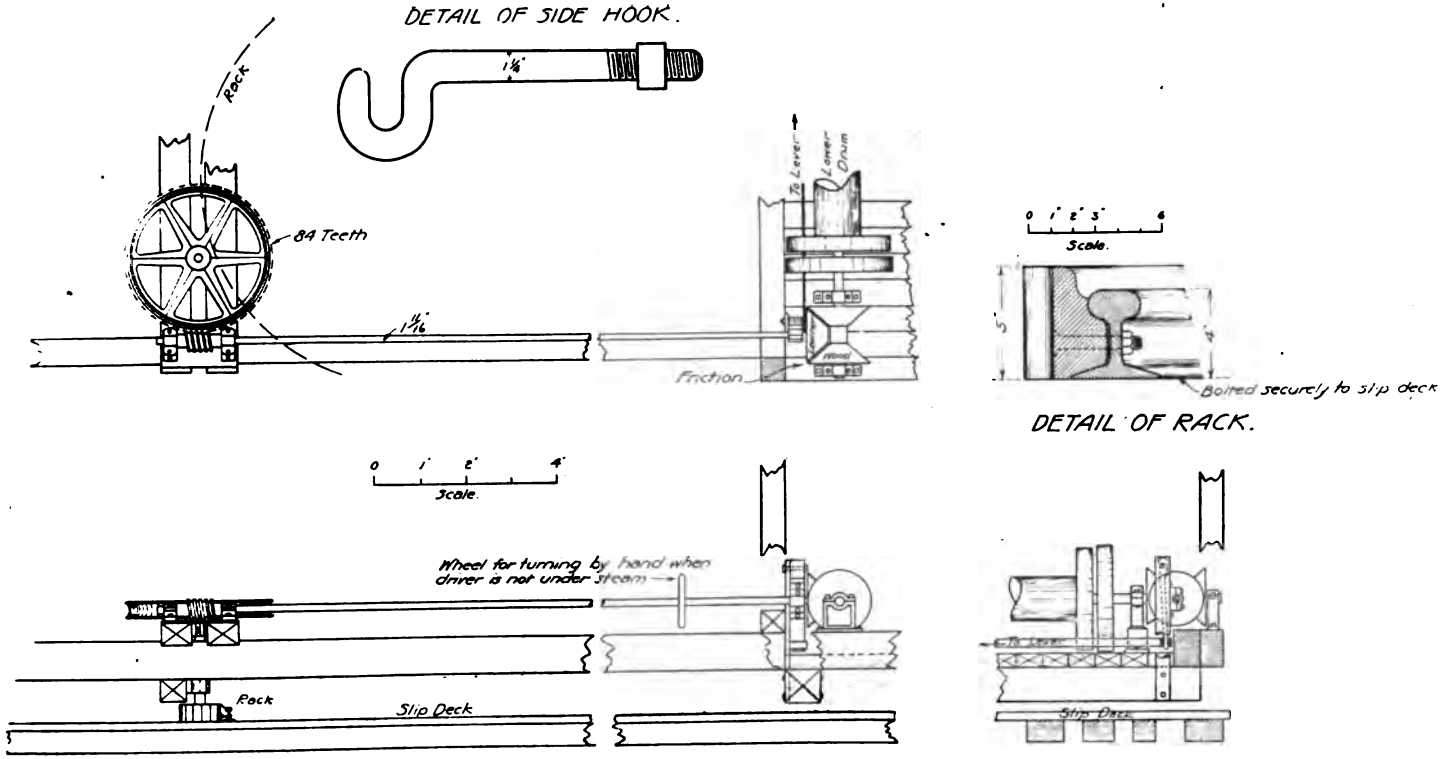


Fig. 79. Details of Pile Driver Car, Boston & Maine R. R.

laine R. R.

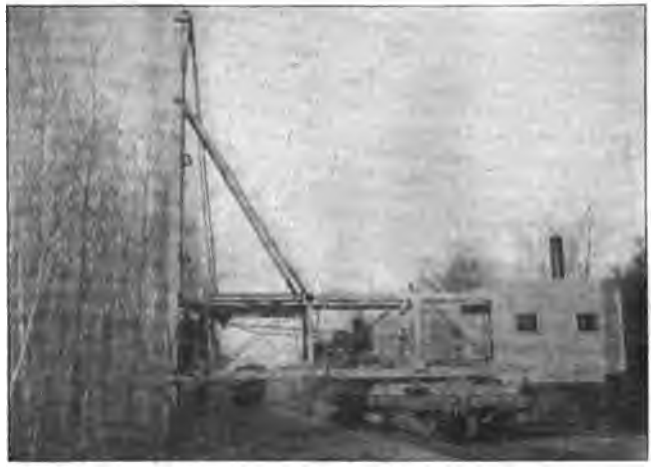


Fig. 81. Pile Driver Boston & Maine R. R. Reaching over one track.

FIG. 82. Pile Driver Boston & Maine R. R. Driving 16 ft. Bents.

KAUKAUNA, Wis., Aug. 22, 1902.

Mr. B. F. Pickering, Supt. B. & B., Boston & Maine R. R., Sanbornville, N. H.

DEAR SIR: Allow me to plead guilty to the charge of neglecting an answer to your request regarding description of pile driver in answer to Subject No. 6. I have lost the circular and the best way to answer now is to send you a blue print of the pile driver which I had remodeled last spring. While it is not altogether my idea of an ideal pile driver, as I had to take into consideration existing circumstances and fit the alterations to certain parts of the old driver, I can say that the several features of the driver as remodeled have given entire satisfaction. We have driven some 1,500 piles with this driver and have used the battering feature of leaders to a great advantage. We drove a great many 60 feet piles and found the arrangement admirable. The prominent feature of driver is a combination hinge which provides for the lowering and raising of leads and the swinging of leads for battering purposes, and we can raise and lower our leads, which is done by means of an auxiliary drum, in two minutes and have frequently lowered leads while driver was running to a side track to get out of the way of a train so that we would be utilizing every available minute. My idea of an ideal pile driver is really embodied in a driver that has been built by the C., M. & St. P. Ry., after designs by Messrs. W. E. & G. W. Smith. You undoubtedly have plans of this driver.

Yours truly,

(Signed) H. RETTINGHOUSE,
Supt. B. & B.

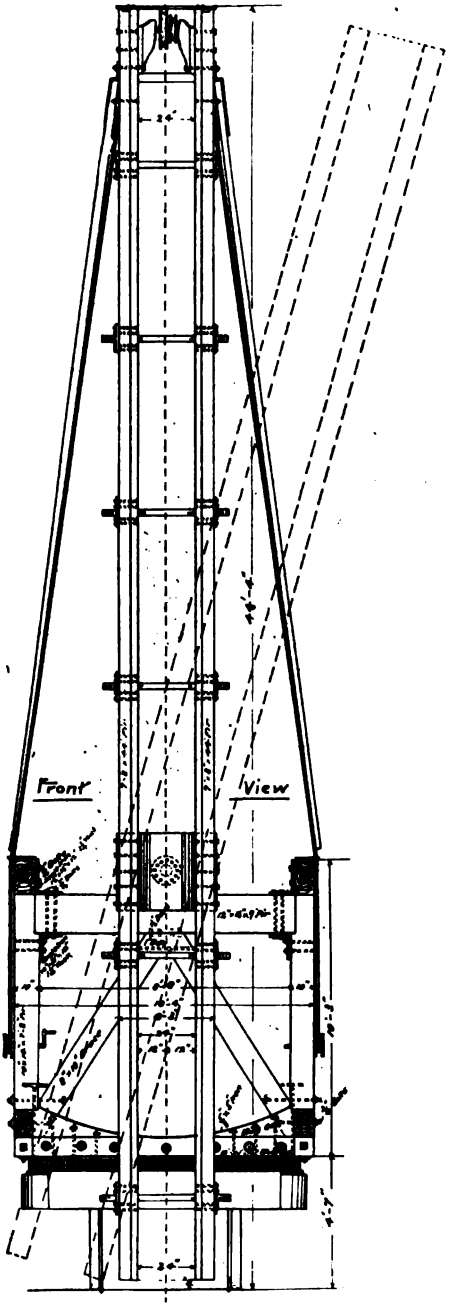
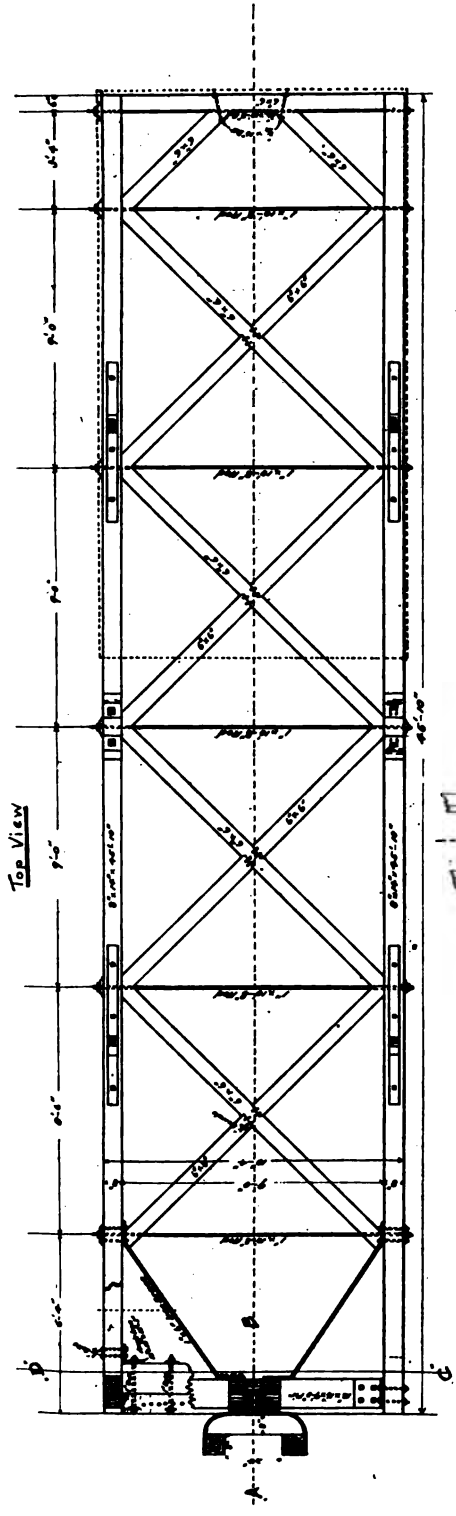
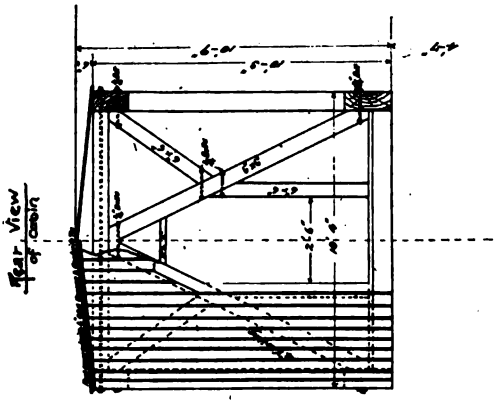
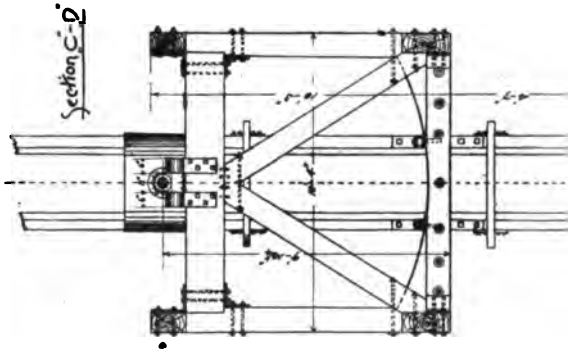
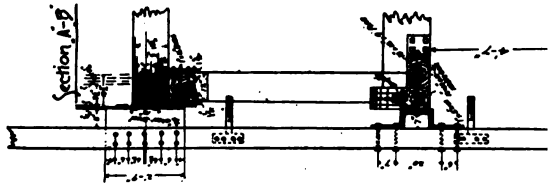


Fig. 83. Chicago & North Western Ry. Pile Driver.


Top View


Rear view of Beam


Section C-D


Section A-B

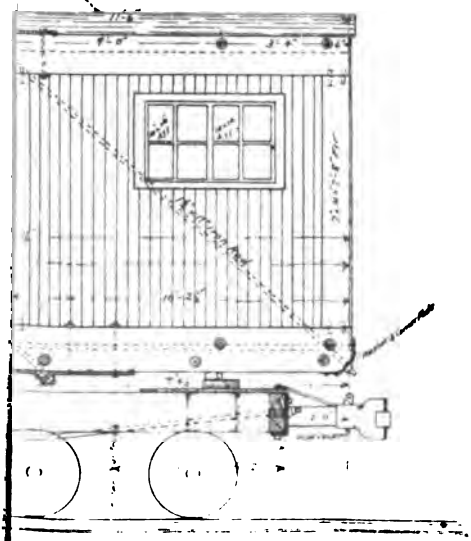
CLEVELAND, O., Sept. 4, 1902.

B. F. Pickering, Chairman, Sanbornville, N. H.

DEAR SIR: Referring to your circular, No. 6.

I hand you herewith such information as I am able to furnish relative to pile drivers and send you under seperate cover plan showing general arrangement and some of the more important details of a pile driver which we have recently had built for us by Messrs. Kaltenback and Griess of this city, after design furnished by us.

This driver has given excellent service and I think has more good points and fewer objectionable features than any pile driver I have ever seen. It was patterned largely after one we built in our own shops several years ago after my own ideas, the details being worked out in our draughting room. My idea of the best pile driver is one which will work close to the end of the car when necessary, where 75% of the driving is done, as in ordinary renewals, repairs, etc., and which can also be made to drive 16 feet ahead for building new work, taking care of washouts and similar work where we have to build as we go. It is also desirable to have a driver that will work on both ends of the car to avoid as far as possible turning the machinery in working on different jobs. It is also desirable to be able to drive piles as far out from the center of the track as practicable in order to take care of foundations, second track, trestles, etc. I think it should be able to drive piles 20 feet from the center of the track on which it stands. It should be self-propelling, and move itself easily and quickly for short movements, as well as for ordinary running, and should be able to raise and lower the leaders by steam. I do not advocate pendulum leaders, but prefer to point a draw on the piles, and draw in the tops to give them batter. In regard to length, width, and height of car. It should be as short, narrow, and low as is practicable to make it and still have it carry the necessary machinery and equipment so that it may be used in close places and pass under low bridges. In regard to the best method of turning driver on the car. I think a rack at the front end of the car and a pinion on each of the sills for swinging and holding the leaders is the best that I have seen. My driver will raise and lower the leaders in less than 3 minutes for each operation. The leaders should be from 36 to 40 feet long and the hammer weigh from 3,000 to 3,500 pounds. This would require 1¼-inch manilla rope or ¾-inch steel cable. It is often desirable to have a driver rigged with a boom to use as a derrick, and mine is so equipped, and within the last month have handled all the iron in the erection of a 105-foot span Pratt truss bridge, carrying it out to place and holding it there while it was being connected, the bridge being built along side of the main track. I do not consider 100.000 pounds excessive for a pile driver complete, as I have two which weigh more than that, and it requires a



pretty heavy weight to hold the driver firmly on the track, in holding large piles and a heavy hammer. On the other hand there are occasions where a light driver is desirable, as in work on new track on soft ground, or on very old bridges where there is much old timber.

My pile drivers fill all the conditions I mention above as being desirable in a driver, that is, they will drive close to the end of the car at one end and will reverse and drive 16 feet ahead at the other end, the center of the table being about 6 feet nearer one end of the car than the other. The leaders raise and lower with steam; they will drive 20 feet out from the center of the track on which they stand; are self-propelling, will move themselves easily and will run at a speed of 10 miles on ordinary track. One engine handles the piles, hammer, and propels the car. I have a 35 horse-power boiler and engine.

About the only improvements I could suggest in this driver as a result of something over a year's experience with the new one, would be heavier sills and stiffer upper truss for the sills to prevent rocking.

Yours truly,

(Signed) R. H. Reid,

Gen'l Bridge Foreman, L. S. & M. S. Ry. Co.

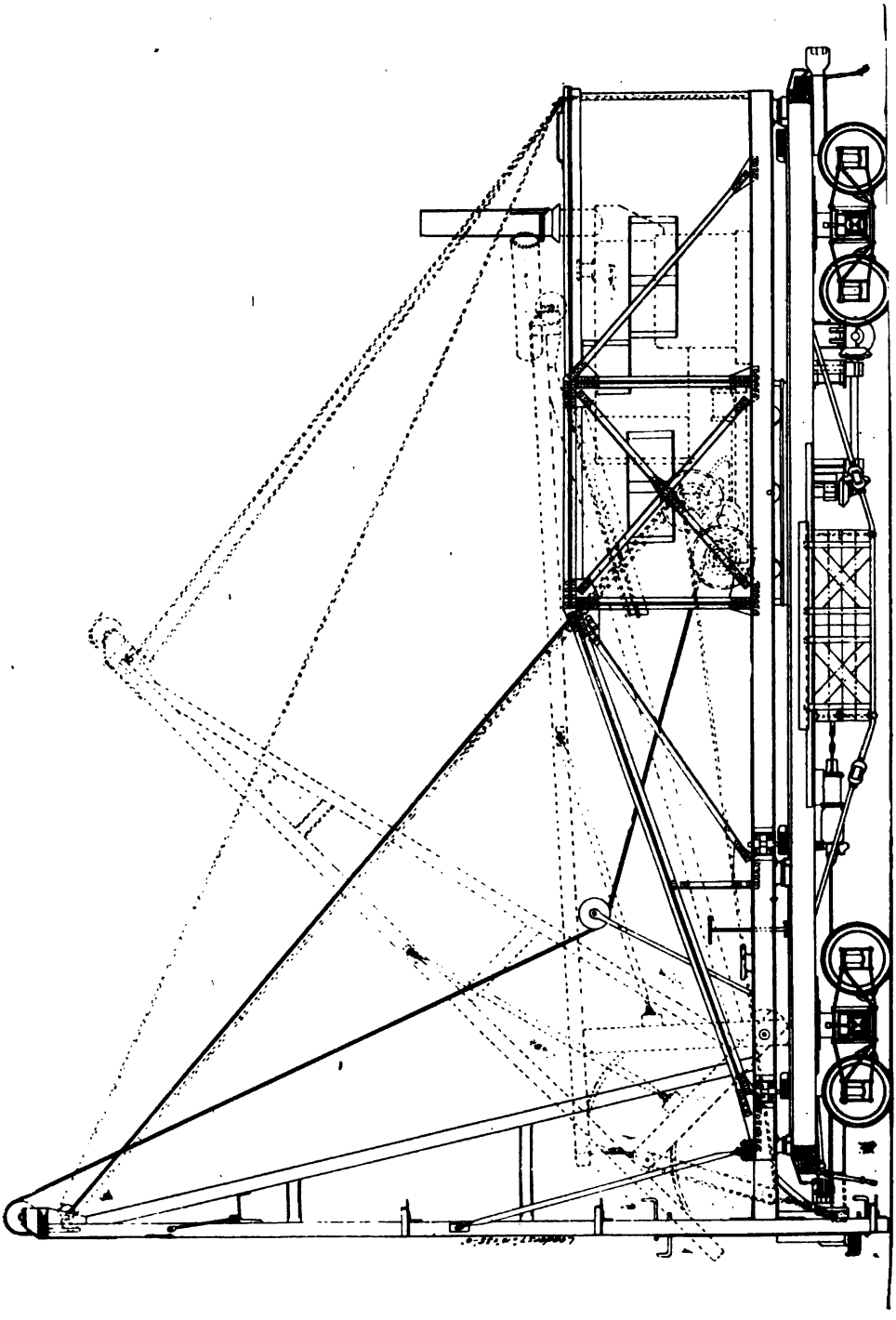
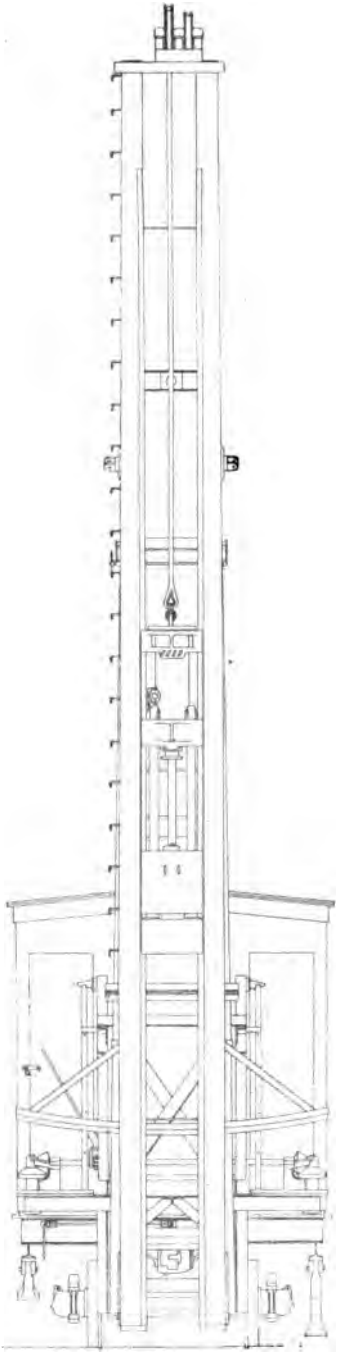


Fig. 86. Lake Shore & Mich. Southern Ry. Pile Driver. Built by Kaltenbach & Griess, Cleveland, O.

FIG. 87. Pile Driver L. S. & M. S. Ry. Driving 16 feet ahead of car.

FIG. 88. Pile Driver L. S. & M. S. Ry. Driving 20 ft. from centre of track.



SPECIFICATIONS FOR No. 2, VULCAN CAR PILE DRIVER, ACCOMPANYING TRACING 2624, FOR INSERTION IN REPORT.

VULCAN CAR PILE DRIVER—NO. TWO STYLE—ALL STEEL; DOUBLE ENDER.

Body—36 feet long, 10 feet wide; having two side sills of 15 feet I-beams, four center sills of 10 feet I-beams, with riveted diaphragms; extra body transoms to move both trucks back to; normal reach to center of pile from center of nearest axle, at either end of car, 13 feet 2 inches; extended reach when truck is moved back to extra transom, at either end of car, 20 feet 6 inches; sidewise reach across tracks to center of pile from center of car, 28 feet 1 inch; greatest angle of batter each way from the vertical, 9° (about 1 in 6¼); distance from vertical center of car to center of batter pile, at level of top of rail, 4 feet 9 inches; superstructure in center of car.

Superstructure—mounted on a turntable of bridge form, having wrought steel treads, machine finished; radial rods and conical rollers, steadying the ends by rollers running on tracks; weight thrown on center, making it very easy to swivel; extreme height from top of rail, when driver is arranged for traveling—stack removed—15 feet.

Leaders—40 feet high, of wood, lined with channel iron; suspended on a pin near top of false leaders, requiring little lateral motion of the sheaves at head.

Engine—double, 7x10; double drum.

Boiler—42x96 upright.

Drop Hammer—2,800 lbs.; fitted with a Casgrain patent pile cap.

Steam Hammer—No. 2 "Warrington" style; weighing 6,500 pounds.

Weight of Machine—with drop hammer, 73,500 lbs.; with steam hammer, 80,000 lbs.

SPECIFICATION OF STEAM PILE DRIVER.

TYPE NO. ONE AS MANUFACTURED BY THE INDUSTRIAL WORKS, BAY CITY, MICHIGAN.

Car body is of white oak construction throughout. Longitudinal sills, ten in number, are 5½ inches x 13¾ inches x 35 feet 8½ inches long. End sills are 9 inches x 13¾ inches x 9 feet 8 inches long. Intermediates are 5½ inches x 13¾ inches. Total length of car body 37 feet 2½ inches; width over bolt ends 10 feet. Body tied together with 1-inch bolts, and is stiffened with eight 1¼-inch trusses, having 1¼-inch ends, four of which are inverted. Decking of car body is of 1¼-inch tongued and grooved white oak, laid in narrow widths.

The trucks supporting the car body are of special design. Iron truck is of the diamond type, arch bars 1½ inches, 1½ inches and ⅝ x 5 inches wide, bolster of two 9-inch steel I-beams, springs spiral h four coil nests, axles with M. C. B. journals, 5 x 9 inches bronze bearings. Rear wheels, when driver is self-propelling, are arranged in pedestal jaws, axles 5 inches diameter. All wheels are 33 inches in diameter, cast iron, weighing 650 lbs. for front and 600 for rear.

Forward end of car, under turn-table, is provided with a locomotive tender type automatic coupler. Rear end is provided with a standard automatic coupler, both of the Janney type. The forward truck is provided with metallic brake beams with Christie shoes.

The machinery for hoisting the hammer and raising the pile into position is a cone friction drum hoisting engine, with double steam cylinders, each 8½ x 10 inches. A drum is provided for each purpose, and these drums are supplied with ratchets and pawls. The friction clutches are supplied with ratchets and pawls. The friction clutches are operated by tool steel screws and plungers, working in oil boxes, and suitable short stroke hand levers.

Unless otherwise specified, the driver is constructed with a self-propelling attachment, and this necessitates equipping the engine with a reversing link motion counter-shaft under the car, and a system of gearing and chain work, connected with the rear axles, all of which may be easily connected or disconnected. This device ensures a means for the driver moving with its own power at a speed not to exceed eight miles per hour, and by its use a locomotive may often be dispensed with.

Steam for the operation of the engine is generated by an upright boiler, 52 inches diameter, 8 feet high. Shell, fire box, and heads are constructed of the best flange steel. The fire box is of ample size; an upper combustion chamber is provided, and the flues, at all times submerged, are thus protected from

the action of the fire. These flues, 136 in number, 2 inches in diameter, and each 3 feet 6 inches long, are secured to the lower head with copper ferrules. The boiler is equipped with lever shaking grates, smoke-stack, pop safety valve, injector, steam gauge, water gauge, and gauge cocks, and has a jacket of asbestos, wood and Russia iron, neatly applied.

The leaders are carried upon a steel truss, the bottom members of which are two 15-inch I-beams. This truss rests and extends upon a turn-table. This turn-table is accurately and strongly constructed with conical rollers and turned roller paths. A system of rollers entering the channels of the truss beams allows the truss to be extended to a distance of 16 feet from the wheel base of the car, and with the use of the turn-table, operated through a train of gearing, the leaders may be slewed to 12 feet on either side of the center of track when truss is extended full distance, or to 14 feet on either side of center of track if truss is drawn in to an extension of about 12 feet.

Upon the rear of this truss there is provided a counter-weight for the leaders and hammers. This counter-weight consists of a box constructed of steel plate to contain 5,000 pounds of steel or iron scrap. This scrap may be of any close lying material, such as scrap coupling pins, links, plate punchings, etc., and is to be furnished and put in place by and at the expense of the purchaser.

The leaders, ordinarily 37 feet high, are constructed of Norway pine, of dimensions 8 inches x 12 inches at the bottom, and tapering from the swinging point to 8 inches x 8 inches at the top. They are provided with wood filling pieces, entering 6-inch steel channels, running their full length and forming the ways for the hammer. This arrangement gives strength and durability. A series of forged distance pieces holds the leaders in position relative to each other, while the whole is supported at the front of the truss work, and through the braces running from the top of the leaders to the rear of the truss.

The leaders are raised and lowered by means of a winch attached to the truss and easily operated, the supporting braces being easily detached at their lower extremities, swinging into a vertical position alongside the leaders and assuming a horizontal position with them. The same winch is also used in extending or drawing in the truss.

The rear portion of the car, containing the boiler and the engine, is covered with a pine cab, neatly constructed, and having windows and doors in proper positions.

The driver is ordinarily supplied with a drop hammer weighing about 2,500 pounds. The equipment includes special steel hammer line, manilla pile and truss extension lines, with the necessary snatch block, and everything complete ready for operation.

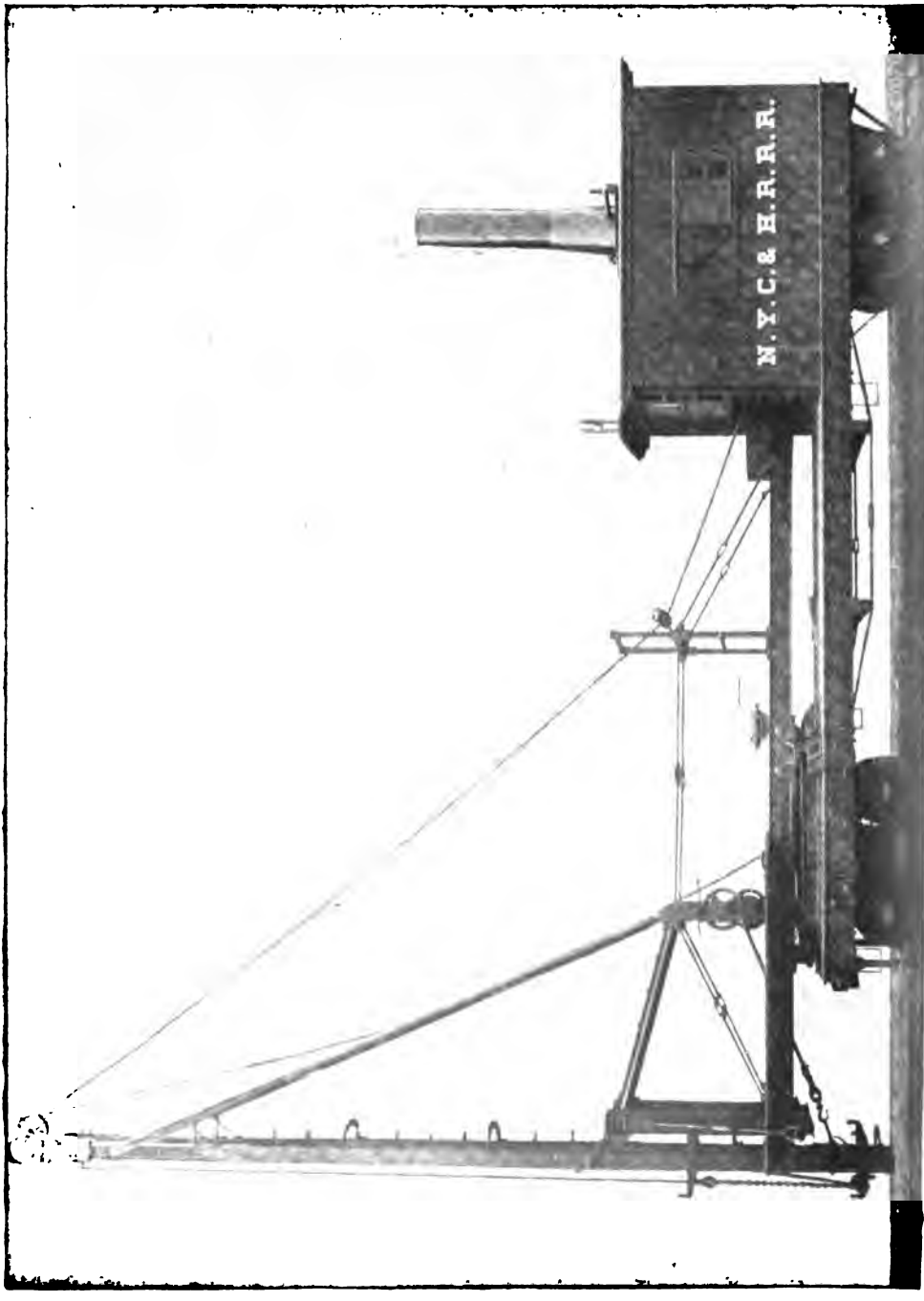


Fig. 80. Pile Driver Built by Industrial Works, Bay City, Mich.

Fig. 91. Track Pile Driver with Steam Hammer, Gulf, Colorado & Santa Fé Ry. Industrial Works, Bay City, Mich., Builders.

DISCUSSION.

Mr. Pickering.—Mr. President, I don't know that it is necessary for me to make any statement any further than what the committee has compiled. However, since arriving here I have received some intimation from many members that they are very much interested in this question, and I would therefore like to hear from any one who has any suggestions to make in regard to this matter, or any criticisms.

Mr. Reid.—Mr. President, we have on the Lake Shore three pile-drivers in active service and one that is on the retired list. We have one Bay City driver, one which we built ourselves, and another which was built two years ago by contractors for us after our designs. The report shows a general diagram of the last one built by the contractors. It is a driver that works close to the car at one end, and by swinging around will drive sixteen feet ahead from the other end, has a thirty-two hundred pound hammer, leads long enough to take a thirty-foot pile, is self-propelling for a speed of from ten to twelve miles an hour, and will start itself on any grade that a train will start on. With this driver I have worked twenty-eight feet out from the centre of the track, but, of course, very rarely have occasion to drive out as far as that. To drive out that far the driver has to be swung square across the car, but can handle twenty-five-foot piles at that distance. We can, and have handled sixty-foot piling twenty feet out from the centre of the car. It has more good points and fewer objections than any other driver that I know of, and I like it better than the Bay City driver, as it is stiffer, and we can pick up the biggest piles we have to handle with it and it stands rigid and firm.

Mr. Markley.—In reference to the self-propelling driver I would like to ask Mr. Reid if he has a regular train crew to handle the driver when out on the main track or not, etc.?

Mr. Reid.—We have no regular train crew, my pile-drivers are operated the same as the regular trains. The foreman gets working orders from the dispatcher's office just the same as a

conductor and a copy is furnished the pile-driver engineer. Of course, when working on the main track we have to flag, but we do not have to depend on the train crews; if we have one or two cars of material to distribute, we distribute it as we go. We can run about ten or twelve miles an hour and can handle three or four cars very nicely.

Mr. Killam.—What is the cost of that kind of a pile-driver!

Mr. Reid.—I think ours cost about five thousand dollars.

Mr. Pickering.—I would like to say in regard to the operation of these pile-drivers, that the Boston & Maine driver which you see illustrated in this report is not equipped for self-propelling, and we do not consider it wise on our system. It would be very hard to make our operating department believe that we could operate successfully the pile-driver outfit, which is practically a train without a train crew. If some of the gentlemen are able to do it, it is a nice thing no doubt, but for all of our work we believe it is the most economical to have a pile-driver operated by a regular locomotive, therefore our pile-driver is not thus equipped. In regard to the range of work possible I think it will surprise some of the gentlemen if they will look this matter up closely, and, as one gentleman informed me, he said he had a driver that was very efficient but said that he had never used it himself. Now, gentlemen, you will find if you use the driver yourself you will wish you had something better; that has been my experience anyway, and with that end in view the object of your committee has been to get the very best points from every one possible, and while we don't wish to criticise any gentleman's opinion I really do believe that if you will go into this matter carefully you will find that you have not got the best driver possible.

Mr. Killam.—In reference to movements of our pile-driver I would say that if the driver is sent out a long distance it is put in the regular freight trains, that is, where it is sent out one or two or three hundred miles, it is put in a regular train and handled the same as other freight cars.

Mr. Pickering.—I think there is no doubt but what it will be admitted by all that it would be very convenient many times for general service to have a driver that is self-propelling, but

the thought that we tried to work out in the construction of our machine was to save on the cost in the handling of the driver and to so construct it as to be able to do the work at the lowest possible cost, and therefore we substituted steam for hand power in every place possible. All the movements of our driver, such as the swinging around, or turning from one end to the other, are accomplished by steam power, and so our driver is handled with several men less than the ordinary driver that is operated by hand power. For instance, we had occasion to test our driver in connection with a Bay City driver last winter in the case of a wrecked bridge, which was a very severe test. While it took for the swinging of the Bay City driver four to eight men we were enabled to handle our driver at a great deal less expense with the ordinary number of men, as all the swinging was easily done by steam power. You understand it was in the dead of winter and stormy weather, this being the reason for the great difficulty in swinging the Bay City driver into the various positions necessary to get the supporting piles in at the point desired, using piling sixty-five feet long. We could, however, very easily attach a self-propelling arrangement, but if it is done I think it always advisable to do so with an extra engine, because any reversing engine, as any practical mechanic will tell you, is not so quick in operating as a direct acting engine. Therefore, I do not think it advisable to propel this pile-driver by its own engine, or rather the engine used for the driving of the piles, but for a self-propelling arrangement I would advocate putting in a separate small vertical engine to propel the driver.

Mr. Markley.—According to Mr. Pickering's idea some railroads have made a mistake in having double engines; they should all operate one way, as I understand Mr. Pickering's meaning. As for handling the Bay City driver, I must defend that driver because we are using it with good results. We have an arrangement on our driver for use in swinging leads around from one side to another by one man without any trouble. Another thing, it costs on our line two dollars and ten cents an hour for a train crew and engine, and is charged up to us at that rate, when we call for a locomotive to handle our pile-

driver outfit which is seldom the case, unless going to a great distance. Our driver is self-propelling, and we always handle it with our own men, and we figure that if a bridge foreman is competent to tear out a bridge, he is certainly competent to handle the pile-driver on the main track under all conditions.

Mr. Pickering.—Mr. President, we understood this morning that Mr. Markley had buried the hatchet but we will take up the war again, and I shall stick to my statement, that no reversing engine can be so quick of operation as a directly connected valve engine. It is utterly impossible to make them so, and if you will ask any competent engineer or master mechanic in this country they will tell you that, were it possible, they would like to have all their engines directly connected so they would not have to be reversed. Any link motion must necessarily give you more or less lost motion,—it is absolutely necessary that it must be so. I think we have made some records with our machine that it would be hard to equal with any self-propelling machine operated with a reversing engine. There was one in particular, which was a very difficult piece of driving. On the job I speak of we have a record of driving twelve sixty-five-foot spur piles in four and a half hours, making siding for seven trains, and ran two miles to take water in that time. I think you would have a hard time to equal that with a self-propelling machine.

Mr. Sattley.—One word in favor of the Bay City machine. I had occasion to do some driving with our driver for the engineering department, and of course wanted to make a good record. They were retaining piles and of course not very long, running from eight to ten feet in length, just had to drive about half their length in the ground. We started at four thirty in the morning and finished at two thirty in the afternoon and drove one hundred and fifty piles.

Mr. Pickering. —The piling that I refer to were driven in thirty feet of rushing water in a wild mountain stream, with large quantities of floating ice, making very difficult work.

Mr. Sheldon.—We have a self-propelling driver and we use it about half the time without a locomotive and half the time it depends upon the location of the work we have to do. It

will travel about four miles per hour and if a side track is close to the work we generally do not need to have a locomotive, but if the side track is some distance away we have found it advisable to have a regular train crew as we can save time, get around in better shape, and do more work.

V. Best Material and Designs for Roundhouse Pits, including Drainage and Rail Fastenings.

REPORT OF COMMITTEE.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your committee on the subject, "Best Material and Designs for Roundhouse Pits, including Drainage and Rail Fastenings," have the following report to make:

The responses to our circular asking for information and plans that would bear on the above subject, we are sorry to say, were very few and brief.

For engine pits we recommend a pit as shown in the accompanying plan. The bottom of the pit to be made convex so a man working under an engine will be out of the water. Floor of pit to drain toward turn-table and have a fall of at least 12 inches. Sewer drainage around house of six stalls or more should be at least two feet in diameter. The feeders to this sewer should be at least 9 inches in diameter. The sewer to go through the end of each pit as shown in the plan—cast-iron grates being used to keep out rubbish.

A sewer built in this way can easily be rodded out and kept open. After sewer leaves the roundhouse it ought to have a manhole at least every 100 feet with a pit in each manhole below the sewer so the soft mud and refuse will be deposited. These manholes should be frequently cleaned out.

The thick mud, scales, etc., that come out of locomotive boilers will soon stop up the sewer unless it is looked after.

For walls and bottom of pit concrete is recommended as shown in the plan.

For rail support and fastening, iron plates, as illustrated and described in the 1898 proceedings, page No. 104 A, are recommended. Attached plan shows this plate. It is made of old base plate set flush with the top of concrete. The cost of labor making over old plates was $8.38 per pit. Plates cost $4.10 per pit, making a total of $12.48 per pit for rail support and fastenings.

These plates were used on twenty-one stalls at Winona, Minn., and no repairs whatever have been necessary since the work was done.

If the house is heated with hot air, the conduit can be let

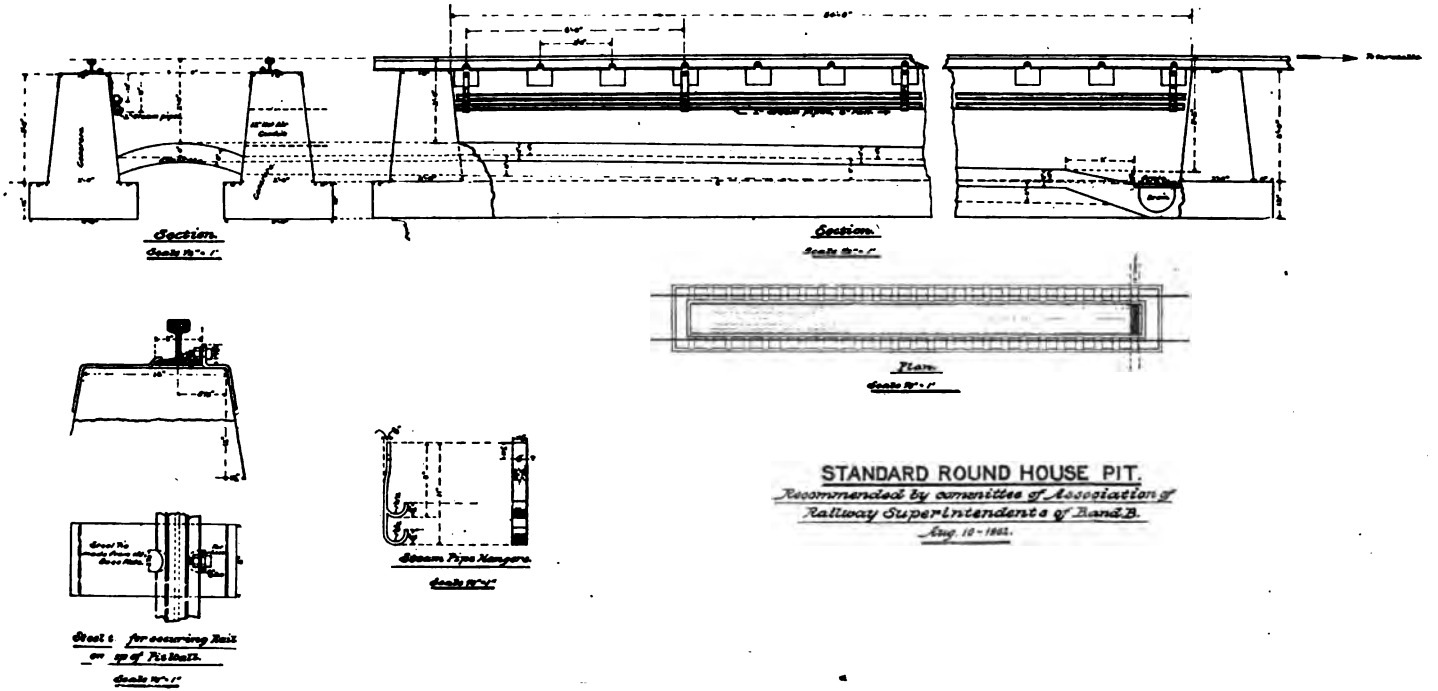


Fig. 92. Standard Round House Pit.

directly into the pit through one of the side walls as shown in the plan.

If heated by steam the steam pipes can be hung on the concrete wall as shown in the plan.

This concrete can be put in for about $5.00 per cubic yard.

Respectfully submitted,

ARTHUR MONTZHEIMER,
E. M. GILCHRIST,
JAMES STANNARD,
ONWARD BATES,
Committee.

APPENDIX TO COMMITTEE REPORT.

Mr. A. S. Markley wrote as follows :

"Replying to your letter of April 1st in reference to the above subject, I herewith hand you one blue print giving the best construction as I see it for roundhouse and machine shop pits. The entire pit is built of concrete. The print you will notice gives two different ways of constructing these pits. We have one constructed like the print on the right which has been in service only about six months ; so far four or five engines have been repaired on it in our machine shop and I see no defect in it, and I believe any one will be safe in building on this line.

" The one on the left, you will notice, has a plank bolted with anchor bolts to the concrete and the edge of plank cut out to fit the rail, which makes a good fastening.

"Both of these are good, I believe. I have never seen any similar to either one of them. They are our own ideas, and I believe they will do what they are designed to do in every particular, but I should hesitate to put either one under main track. Take the cinder pits where there is a good amount of running over them with high-speed trains without iron chairs under rails to relieve them somewhat from wearing into the concrete ; while this has not developed yet, it has not been in service long enough and not sufficient travel over it to do so.

"You will note the blue print is simply a section of the cinder pits which carries with it the idea you are looking for. I have a tracing of this if you desire to reproduce it, which all blue prints should be to convey the correct idea of it."

C. & E. I. R. R.

B & B. DEPT. DANVILLE ILLS.

CONCRETE CINDER PIT.

SCALE 1" = 1' 7-7-02.

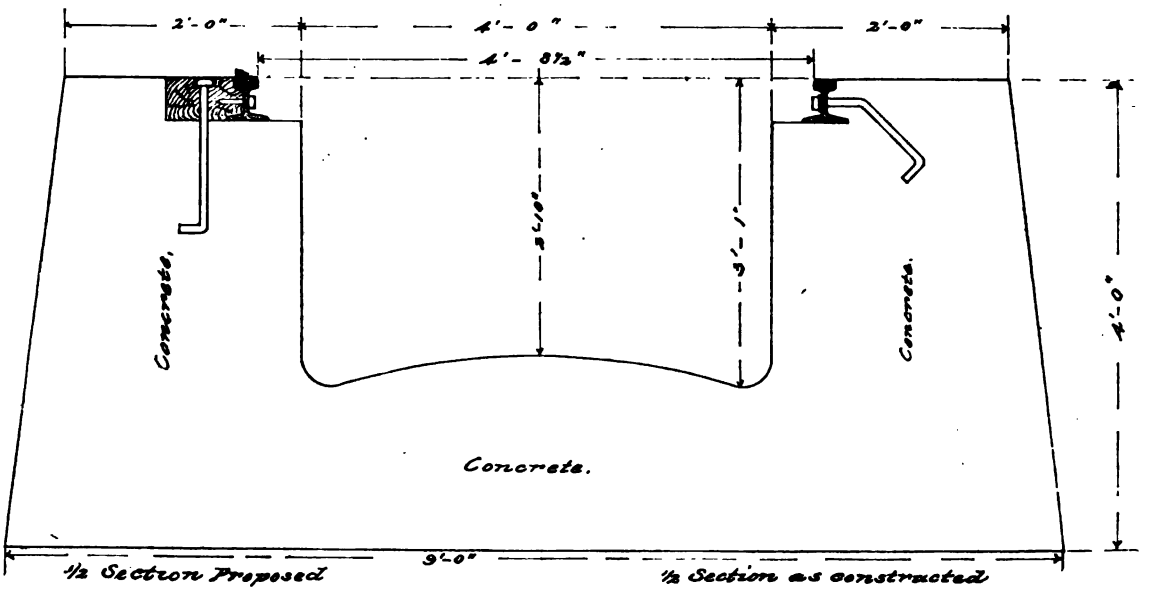


FIG. 98. Concrete Cinder Pit, C. & E. I. R. R.

DISCUSSION.

Mr. Montzheimer.—I have nothing further to say than what is contained in my report, the report I think has been distributed and shows a pit that we recommend, though it is pretty hard to see all the details of it.

Mr. Markley.—I sent in my report, Mr. President, and all I have to say in reference to that subject is, that we aim to do away with wood in the construction of roundhouse pits or machine shop or cinder pits, wherever possible.

Mr. Reid.—Rail fastenings for roundhouse pits referred to in this report are out of my line, that comes in the building department. I have seen more or less of them, of course, but know very little about the cost. I notice the majority are cast, the rail sets on a casting on top of which there is an arrangement for fastening the rail to it with a clip bolt, which has been giving good service; that is the only one I am at all familiar with.

Mr. Alexander.—We use a good many kinds of pits. The concrete in our roundhouses is mostly so arranged that the water runs along on each side and drains to the outlet and this outlet to the sewer is always protected so that cinders and waste will not get into it. On top of the wall we lay an eight by twelve hard pine stringer and we fasten our rail with ordinary track spikes to that stringer.

Mr. McIntyre.—On our road for a good many years we used wood, but have done away with it entirely and have substituted stone.

VI. Best Materials for Wearing Surface of Roadway of Highway Bridge Floors.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee appointed on Subject No. 8 begs leave to submit the following report:

Circulars were sent out to a large number of the members of our Association for information on this subject, embracing the following questions:

1. Kind of bridge?
2. Kind of material?
3. Cost of material?
4. Durability of material?
5. Is traffic heavy or light?
6. If overhead, how protected from exhaust of engines or damage by fire?
7. Weight per square foot of flooring?

Send tracings if possible.

Herewith please find report from our members as received on this subject:

Mr. B. F. Pickering, superintendent of bridges and buil ings, Boston & Maine R. R., reports as follows:

1. Wood.
2. Hard pine timber, white pine floor plank.
3. $25 per M.
4. 15 years.
5. Mostly light.
6. No protection.

Mr. M. Riney, superintendent bridges and buildings, Chicago & North Western R. R., advises the following:

1. Timber and second-hand iron spans.
2. Pine.
3. $14 to $18 per M.
4. 15 to 20 years.
5. Light.
6. Directly over track, a wood apron made out of pine flooring.

Mr. C. P. Austin, supervisor bridges and buildings, Boston & Maine R. R., reports the following conditions existing:

1. Wood and iron.

2. Hard pine.

3. $25 per M.

4. 6 to 8 years.

5. Generally heavy.

6. No protection used, as I put the first floor of 3 inches, then the second floor of 2 inches on top of the first. Both floors of hard pine. When the top floor is worn out, the bottom one being good, it is then recovered with another 2-inch floor, thus making the bottom one last from 10 to 12 years before it is renewed.

Mr. J. B. Sheldon, superintendent of bridges and buildings of the New York, New Haven & Hartford R. R., reports the following:

1. 24 wood stringers, 7 wood trusses, and 17 iron trusses and girders.

2. 3-inch plank, Trinidad asphalt, granite blocks.

3. Wood, $0.15 per square foot; asphalt, $0.20 per square foot; granite, $0.28 per square foot.

4. Wood, average 6 years; asphalt 6 to 15 years, according to traffic; granite, 20 years.

5. Generally heavy.

6. No protection.

7. Wood, 12 pounds; asphalt, 50 pounds; granite, 100 pounds.

We have found that with a traffic that will wear out 3-inch plank in 2 years, Trinidad asphalt will last from 6 to 7 years. Our experience has been that where a large volume of business is done, requiring a strong bridge with a wearing surface of asphalt, concrete, or granite blocks, it will last enough longer to more than pay for the extra cost of a bridge strong enough to carry the added weight and the expense of an under floor to support the concrete or paving.

The following from Mr. Arthur Montzheimer, superintendent bridges and buildings, Chicago & North Western R. R.:

On our ordinary country bridges we use 3-inch pine plank, and some of our city bridges, and plank with 3-inch oak plank. In Chicago we have two viaducts covered with 7-inch yellow pine blocks cut from 4 to 6 and 4 to 8-inch plank. The I beams in the floor are covered with 3-inch pine plank, and the blocks set

directly on this floor. The blocks cost $1.42 per square yard, and paving pitch used to cement the blocks is $0.04 per square yard and labor $0.23 per square yard, the total cost per yard being $1.69. I consider this kind of paving as durable as any that can be put down, and traffic is very heavy on these viaducts. The bridges are not protected from exhaust of engines in any way, except over the few tracks where the traffic is very heavy. At this point we build a roof, which is hung under the "I" beams on the floor of the bridge. This roof is built out of D. and M. ceiling and slopes so that the sweat from the viaduct will not drop on the engines.

Mr. H. H. Eggleston, supervisor bridges and buildings of the C., C., C. & St. L. R. R., reports as follows:

1. Wood and old girders.
2. 4-inch oak plank.
3. $20 per M.
4. Wood, 7 to 10 years.
5. Heavy.
6. No protection.

Mr. A. Shane, superintendent of bridges and buildings of the Toledo, St. Louis & Western R. R., writes that they have no overhead bridges of any importance other than common highway overhead, and only use wooden floors. Have had occasion to use rail- and tile-covered roofs in underground tracks in tunnels, either of which have proved very durable; I, however, prefer the tile.

Mr. A. S. Markley, superintendent bridges and buildings for the Chicago & Eastern Illinois, advises that he uses white oak plank 4 inches thick, laid on 6-inch string pieces 2 feet apart. The space between these string pieces is filled with stringers or gravel. This costs $10 per M. laid, and will last from 6 to 8 years, depending altogether on the amount of travel. Where traffic is very heavy it will not last to exceed 3 years, and will always wear out before it decays. I refer in particular to our team ways in Chicago, where a great amount of teaming is done. This does not apply, of course, to overhead wagon bridges, where a floor of this kind will last from 12 to 14 years.

Mr. J. P. Canty, supervisor bridges and buildings for the Boston & Maine R. R , reports as follows:

In regard to circular requesting the best material for wearing surface on roadway and highway bridge floors, I send you herewith tracings showing style of highway bridge floor construc-

tion used on the division where I am located, which gives a very substantial foundation and presents a long-lasting surface.

1. City highway bridge over railroad tracks, carrying electric railroad tracks.

2. Granite blocks with Portland cement joints.

3. Cost of floor per square foot of roadway,—

Steel	$1.169
Paving and sand	.233
Concrete	.359
Total	$1.761

4. After two years of service the wearing surface is in apparently as good condition as when first built.

5. Traffic is heavy.

6. Bottom flanges of stringers are covered with expanded metal and Portland cement mortar.

7. Weight of floor per square foot of roadway,—

Steel	26.87
Concrete	128.09
Sand	8.30
Paving	66.80
Total	230.06

The following will apply in a general way to our town highway bridges:

1. Town highway bridge over railroad tracks.

2. Georgia pine stringers and plank; two layers of plank, 2 inches on bottom and 3 inches on top.

3. Floor costs $0.40 per square foot of roadway.

4. Top plank will last about 6 years, bottom plank and stringers about 12 years.

5. Traffic not especially heavy.

6. No protection from exhaust or fire.

7. Weight of floor per square foot of roadway, 37 pounds.

The following will apply in a general way to our country bridges:

1. Country roadway bridge over railroad tracks.

2. Georgia pine stringers and plank; one 3-inch layer of plank.

3. Floor costs $0.30 per square foot of roadway.

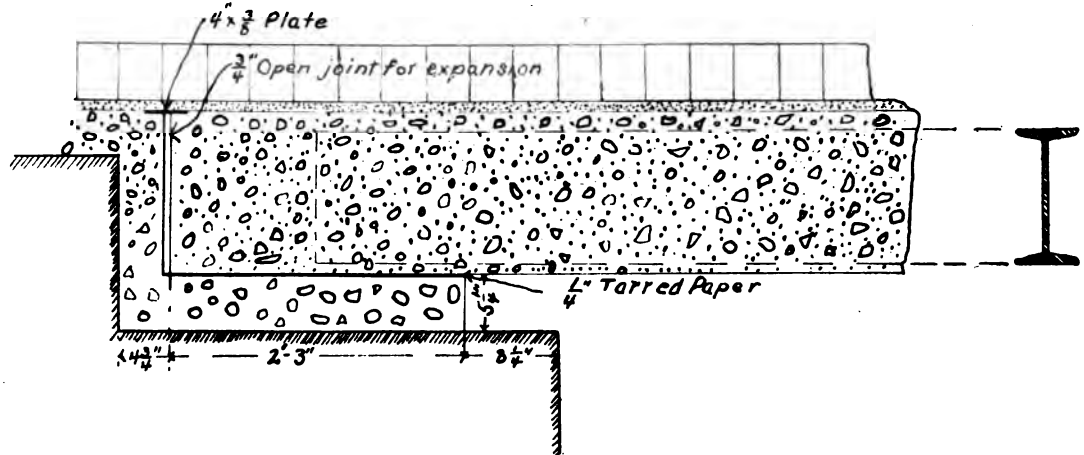
4. Plank lasts 6 years, stringers 12 years.
5. Quite light.
6. No protection from exhaust or fire.
7. Floor weights, 27 pounds per square foot of roadway.

Mr. W. O. Eggleston, master carpenter of the Chicago & Erie R. R., reports as follows:

1. One wood and one iron bridge.
2. White oak.
3. Cost of material, $20 per M.
4. 10 to 12 years.
5. Light.
6. No protection.

W. O. EGGLESTON,
Chairman,

B. F. PICKERING,
J. B. SHELDON,
C. P. AUSTIN,
J. M. STATEN,
O. J. TRAVIS,
Committee.

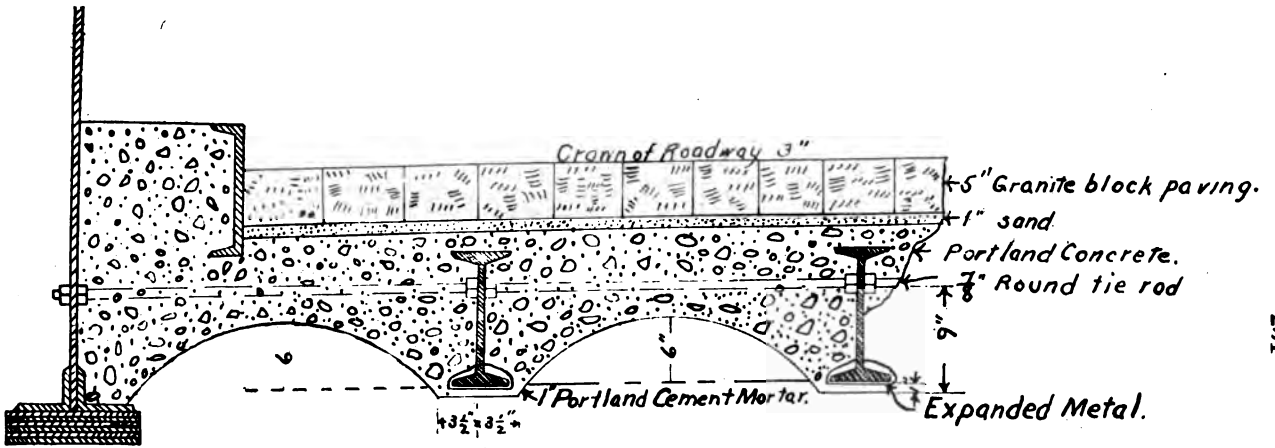


LONGITUDINAL SECTION OF EXPANSION END

Note - Other end without joint + tarred paper.

B. & M. R. R. - Fitchburg Div. - No. 71 - Fitchburg, Mass.

FIG. 94. Roadway, B. & M. R. R. (Fitchburg Division), No. 71, Fitchburg, Mass.



SECTION OF ROADWAY

B & M. R. R. - Fitchburg Div - No. 71 - Fitchburg, Mass.

Fig. 95. Roadway, B. & M. R. R. (Fitchburg Division), No. 71, Fitchburg, Mass.

DISCUSSION.

Mr. Pickering.—Mr. President, I don't think that I have anything additional to say in regard to that report. The report was formulated by Mr. Eggleston and no doubt he has put in the report all the data he received, but I presume there are quite a good many gentlemen here who can give us still more information and I would rather hear from some of the others.

Mr. Reid.—Mr. President, on the Lake Shore most of our overhead bridges have plank floors. We have some bridges that have double floors, but the majority are single, just three inch white oak floor laid on wooden or iron joists. We are using that principally now because we can get it cheaper than anything of the same size and length, but the white oak seems to rot out in many cases before it wears out. In regard to the double floors on highway bridges there is one quite serious objection; that is, it is a very expensive job to maintain the lower floor because you have to take up the whole deck to make any kind of general repairs on the lower floor.

Mr. Cunningham. I think that undoubtedly the best floor would be concrete with expanded metal and a wearing surface of asphalt. That is a floor which can be made entirely water proof and will last longer than any other floor.

Mr. Canty.—I would like to ask the members if, in the use of expanded metal on bottom stringers or floor beams on overhead highway bridges, they have any trouble with the cement adhering directly over the track.

Mr. Cunningham.—Don't know of any.

Mr. Sheldon.—I think where you have heavy traffic the granite blocks make the best wearing surface, but the only trouble is it requires a heavy bridge to support it, but for heavy traffic there is nothing so durable as granite blocks, and, in the end, nothing so cheap, because in many places three-inch hard pine plank floor would not last but a few months. Of course, for putting in the granite blocks the first cost is considerably more, but it makes the cheapest roadway in the end.

LIST OF ANNUAL CONVENTIONS.

First Convention,	St. Louis, Mo.,	September 25, 1891.
Second Convention,	Cincinnati, Ohio,	October 18, 19, 1892.
Third Convention,	Philadelphia, Pa.,	October 17 to 19, 1893.
Fourth Convention,	Kansas City, Mo.,	October 16 to 18, 1894.
Fifth Convention,	New Orleans, La.,	October 15, 16, 1895.
Sixth Convention,	Chicago, Ill.,	October 20 to 22, 1896.
Seventh Convention,	Denver, Col.,	October 19 to 21, 1897.
Eighth Convention,	Richmond, Va.,	October 18, 19, 1898.
Ninth Convention,	Detroit, Mich.,	October 17, 18, 1899.
Tenth Convention,	St. Louis, Mo.,	October 16 to 18, 1900.
EleventhConvention,	Atlanta, Ga.,	October 15 to 17, 1901.
Twelfth Convention,	Minneapolis, Minn.,	October 21 to 23, 1902.

MEMBERSHIP.

Year 1891–2. . . .	Number of active members, 60.
Year 1892–3. . . .	Number of active members, 112.
Year 1893–4. . . .	Number of active members, 128.
Year 1894–5. . . .	Number of active members, 115.
Year 1895–6. . . .	Number of active members, 122.
Year 1896–7. . . .	Number of active members, 140.
Year 1897–8. . . .	Number of active members, 127.
Year 1898–9. . . .	Number of active members, 148.
Year 1899–1900. . . .	Number of active members, 148.
Year 1900–01. . . .	Number of active members, 143.
Year 1901–02. . . .	Number of active members, 171.
Year 1902–03. . . .	Number of active members, 195.

LIST OF OFFICERS OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS FROM ITS ORGANIZATION TO THE YEAR 1902-1903.

YEAR.	1891-2.	1892-3.	1893-4.	1894-5.
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews.
First Vice-President	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle.
Second Vice-President	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford.
Third Vice-President	James Stannard	N. W. Thompson.	L. K. Spafford	James Stannard.
Fourth Vice-President	G. W. Hinman	C. E. Fuller	E. D. Hines	Walter G. Berg.
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid.
Executive Members	W. R. Damon	G. W. Andrews	Quintine McNab	James Stannard.
	G. W. Markley	Joseph M. Staten.	Aaron S. Markley	James H. Travis.
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	Joseph H. Cummin.
	G. W. McGehee	Quintine McNab	James Stannard	R. M. Peck.
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White.
	J. E. Wallace	Aaron S. Markley	Joseph H. Cummin	A. Shane.

YEAR.	1895-6.	1896-7.	1897-8.	1898-9.
President	W. A. McGonagle	James Stannard	Walter G. Berg	Joseph H. Cummin.
First Vice-President	L. K. Spafford	Walter G. Berg	Joseph H. Cummin	Aaron S. Markley.
Second Vice-President	James Stannard	Joseph H. Cummin	Aaron S. Markley.	C. C. Mallard.
Third Vice-President	Walter G. Berg	Aaron S. Markley	G. W. Hinman	Walter A. Rogers.
Fourth Vice-President.	Joseph H. Cummin	R. M. Peck	C. C. Mallard	Joseph M. Staten.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members.	R. M. Peck	W. O. Eggleston	George J. Bishop	Wm. S. Danes.
	J. L. White	W. M. Noon	C. P. Austin	J. H. Markley.
	A. Shane	Joseph M. Staten	M. Riney	W. O. Eggleston.
	Aaron S. Markley	George J. Bishop	Wm. S. Danes	R. L. Heflin.
	W. M. Noon	C. P. Austin	J. H. Markley	Frank W. Tanner.
	Joseph M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman.

YEAR.	1899-1900.	1900-1901.	1901-1902.	1902-1903.
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering.
First Vice-President	Walter A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard.
Second Vice-President	Joseph M. Staten	B. F. Pickering	A. Shane	A. Shane.
Third Vice-President	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman.
Fourth Vice-President	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	N. W. Thompson.	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith.
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick.
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin.
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty.
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston.
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley.

SUBJECTS FOR REPORT AND DISCUSSION, AND COMMITTEES SELECTED AT EACH CONVENTION SINCE ORGANIZATION OF THE ASSOCIATION IN 1891..

FIRST CONVENTION, ST. LOUIS, MO., SEPTEMBER 25, 1891.

Subjects.	Committees.
1.	
Surface Cattle-Guards	Aaron S. Markley, J. B. Mitchell, W. R. Damon.
2.	
Frame and Pile Trestles Complete, including Reraller	H. M. Hall, W. A. McGonagle, G. W. McGehee.
3.	
Framing and Protection of Howe Truss and Other Wooden Bridges against Fire and Decay	J. E. Johnson, G. W. Markley, J. H. Markley.
4.	
Iron and Vitrified Pipe for Waterways under Railroad Embankments	James Stannard, J. O. Thorn, J. E. Wallace.
5.	
Water-Tanks Complete, including Painting, Pumps, Pump and Coal Houses, Wells and Reservoirs	G. W. Turner, R. K. Ross, Q. McNab.
6.	
Interlocking Signals	B. F. Bond, G. W. Hinman, James Demars.
7.	
Depot Platforms, Complete	J. A. Nicholson, Adam McNab, C. B. Keller.
8.	
Paints for Iron Structures	Geo. M. Reid, A. J. Kelley, H. A. Hanson.

SECOND CONVENTION, CINCINNATI, O., OCTOBER 18 AND 19, 1892.

1.	
Discipline, and Benefits Derived, and Who are the Beneficiaries	Geo. W. Andrews, W. R. Damon, T. M. Strain, G. W. Turner.
2.	
Turn-table, Best, with a View of Economy, and Durability, and Strength	G. W. Markley, H. F. Martin, James H. Travis, Charles Walker.
3.	
Water Columns, Best, Cheapest, Simplest, and Most Durable	C. E. Fuller, A. S. Markley, H. N. Spaulding, E. L. Cary.
4.	
Coaling Stations, including Storage Bins and for Coaling Engines	J. E. Wallace. C. W. Gooch, G. W. Hinman. J. H. Cummin.

5.		
Crawling of Rails, and its Effects on Structures.....	Geo. M. Reid, L. K. Spafford, J. B. Mitchell, L. S. Isdell.	
6.		
Guard-Rails on Bridges, Advantages and Disadvantages, and Best to be Adopted	O. J. Travis, Q. McNab, J. F. Mock, J. M. Staten.	
7.		
Platforms, Height and Distance from Rail and Mode of Construction.....	James Stannard. M. Walsh, N. M. Markley, Robert Ogle.	
8.		
Best Bridge, Wood, Combination, or Iron, from 130 feet and upwards, and the Best Method of Reconstruction.....	A. Shane, Walter Ransom, N. Potter, C. G. Worden.	
9.		
Best Method of Elevating Track upon Bridges and Trestles	H. E. Gettys, S. F. Patterson, G. W. Hinman, P. N. Watson.	

THIRD CONVENTION, PHILADELPHIA, PA., OCT. 17, 18, AND 19, 1893.

1.		
Depressed Cinder Pits and Other Kinds	W. G. Berg, Abel S. Markley, G. W. Andrews, C. E. Fuller.	
2.		
Best Method of Bridge Inspection.....	G. M. Reid, J. M. Staten, Geo. J. Bishop, J. S. Berry.	
3.		
Pumps and Boilers.....	G. W. Markley, G. W. Turner, J. B. Mitchell, J. R. Harvey.	
4.		
Maintenance of Pile and Frame Trestle.....	W. A. McGonagle. J. H. Markley, Geo. C. Nutting, John Copeland.	
5.		
The Best Scale Foundation.....	O. J. Travis, Joseph Doll, C. D. Bradley, T. M. Strain.	

FOURTH CONVENTION, KANSAS CITY, MO., OCT. 16, 17, AND 18, 1894.

1.		
Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges	G. W. Andrews, W. G. Berg, J. E. Greiner, E. H. R. Green.	
2.		
Methods and Special Appliances for Building Temporary Trestles over Washouts and Burnouts.....	R. M. Peck, G. J. Bishop, A. B. Manning, C. D. Bradley.	
3.		
Strength of Various Kinds of Timber Used in Trestles and Bridges, Especially with Reference to Southern Yellow Pine, White Pine, Fir, and Oak...	W. G. Berg, J. H. Cummin, John Foreman, H. L. Fry.	

4.		
Best Method of Erecting Plate-Girder Bridges	...	H. M. Hall, J. M. Staten, G. W. Hinman, J. N. Pullen.
5.		
Best and Most Economical Railway Track Pile-Driver	...	J. L. White, A. C. Davis, J. F. Mock, James T. Carpenter.
6.		
Sand Dryers, Elevators, and Methods of Supplying Sand to Engines, including Buildings	...	Aaron S. Markley, H. A. Hanson, A. J. Kelley, J. O. Thorn.
7.		
Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate-Girders and Lattice-Bridges for Spans from 50 to 110 feet	...	W. A. McGonagle, R. M. Peck, W. M. Noon, H. E. Gettys.
8.		
Best Method of Spanning Openings too Large for Box Culverts, and in Embankments too Low for Arch Culverts	...	James Stannard, L. K. Spafford, O. H. Andrews, F. W. Tanner.
9.		
Best End Construction for Trestle Adjoining Embankments	...	G. M. Reid, J. L. Solsson, N. M. Markley, R. J. Howell.
10.		
Interlocking Signals	...	J. H. Travis, W. S. Danes, R. L. Heflin, J. A. Spangler.
11.		
Pumps and Boilers	...	John H. Markley, O. J. Travis, A. Shane, G. W. Markley.

FIFTH CONVENTION, NEW ORLEANS, LA., OCTOBER 15 AND 16, 1895.

1.		
How to Determine Size and Capacity of Openings for Waterways	...	Aaron S. Markley, J. S. Berry, C. C. Mallard, J. L. White.
2.		
Different Methods of Numbering Bridges. Should All Waterways be Numbered?	...	A. Shane, W. O. Eggleston, J. L. Slosson, O. J. Travis.
3.		
Drawbridge Ends, Methods of Locking; and under this head include Locking of Turn-tables	...	H. M. Hall, James Stannard, H. Middaugh, C. C. Mallard.
4.		
Protection of Trestles from Fire, including Methods of Construction	...	R. M. Peck, T. H. Kelleher, A. McNab, W. M. Noon, G. W. Hinman, William Berry.
5.		
Local Stations for Small Towns and Villages, giving Plans of Buildings and Platforms	...	J. H. Cummin, N. M. Markley, J. H. Markley, C. G. Worden.
6.		
Tanks, Size, Style, and Details of Construction, including Frost-proof protection to Tank and Pipes	..	W. O. Eggleston, W. M. Noon, A. McNab, N. W. Thompson.

7.

Shearing of Rivets in Plate-Girders and Cause Thereof	J. M. Staten, R. L. Heflin, J. H. Travis, G. M. Reid.

8.

Best and Uniform System of Report Blanks for Bridge and Building Department	G. J. Bishop, W. O. Eggleston, Onward Bates, M. Riney.

9.

Protection of Railroad Structures and Buildings from Fire	R. M. Peck, L. K. Spafford, B. T. McIver.

10. Brought forward from 1894.

Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges	G. W. Andrews, W. G. Berg, J. E. Greiner, E. H. R. Green.

11. Brought forward from 1894.

Best and Most Economical Railway Track Pile-Driver	J. L. White, A. C. Davis, J. F. Mock, J. T. Carpenter, G. W. Hinman.

12. Brought forward from 1894.

Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate-Girders and Lattice Bridges for Spans from 50 to 110 feet	W. A. McGonagle R. M. Peck, W. M. Noon, H. E. Gettys, G. J. Bishop, Onward Bates.

13. Brought forward from 1894.

Interlocking Signals	J. H. Travis, W. S. Danes, R. L. Heflin, J. A. Spangler.

SIXTH CONVENTION, CHICAGO, ILL., OCTOBER 20, 21, AND 22, 1896.

1.

Methods of Heating Buildings where Three or More Stoves are Now Used	J. H. Cummin, George W. Hinman, George W. Markley, Wm. Berry.

2.

The Most Suitable Material for Roofs of Buildings of All Kinds	R. M. Peck, G. W. Turner, W. M. Noon, N. W. Thompson.

3.

Roundhouse Construction, including Smoke-jacks and Ventilators	Geo. W. Andrews, O. J. Travis, W. O. Eggleston, James T. Carpenter.

4.

Care of Iron Bridges after Erection	James H. Travis, T. M. Strain, H. M. Hall, Walter Rogers.

5.

How to Determine Size and Capacity of Openings for Waterways	Walter G. Berg, Aaron S. Markley, Onward Bates, A. J. Kelley.

6.		
Protection of Railroad Buildings and Other Structures from Fire	W. A. McGonagle, M. M. Garvey, J. D. Hilderbrand, John Foreman.
7.		
Designs for Ice-Houses	W. B. Yereance, C. M. Large, J. H. Markley, Geo. W. Ryan.
8.		
Best End Construction for Trestles adjoining Embankments	C. C. Mallard, W. S. Danes, R. L. Heflin, A. C. Olney.
9.		
Bridge Warnings for Low Overhead Structures	W. E. Harwig, M. A. Martin, E. H. R. Green, Joseph Doll.
10.		
Stock-yards and Stock-sheds, including all Details of Construction	Geo. J. Bishop, W. R. Cannon, O. H. Andrews, James Brady.
11.		
Floor System on Bridges, including Skew Bridges	W. G. Guppy, C. P. Austin, C. W. Gooch, F. W. Tanner.

SEVENTH CONVENTION, DENVER, COL., OCTOBER 19, 20, AND 21, 1897.

1.		
Pile-rings and Method of Protecting Pileheads in Driving	G. W. Hinman, Wm. S. Danes, F. Eilers, E. F. Reynolds, Wm. Carmichael, C. M. Large.
2.		
Cost and Manner of Putting In Pipe Culverts	Walter A. Rogers, Frank W. Tanner, John H. Markley, A. H. King, B. F. Bond, O. H. Andrews.
3.		
Best Floors for Shops and Roundhouses	A. W. Merrick, C. S. Thompson, Wm. O. Eggleston, M. F. Cahill, J. B. Pullen, James Gilbert.
4.		
Roundhouse Smoke-jacks and Ventilation	George W. Andrews, Wm. O. Eggleston. Aaron S. Markley, R. J. Howell, J. T. Carpenter, A. McNab.
5.		
Cattleguards and Wingfences	C. C. Mallard, C. S. Thompson, A. Zimmerman, L. H. Wheaton, O. W. Osborne, R. L. Heflin.
6.		
Prevention of Fire in Railroad Buildings	John D. Isaacs, Wm. A. McGonagle, M. Riney, H. L. Fry, J. P. Snow, Wm. B. Yearance.

7.	
Storage of Fuel, Oil, and Other Station Supplies at Way-stations	Arthur Montzheimer, A. Shane, G. E. Hanks, J. E. Johnson, W. Z. Taylor, E. M. Gilchrist.
8.	
Railroad Highway Crossing Gates	Joseph H. Cummin. J. B. Sheldon, Wm. E. Harwig, G. W. Smith, J. E. Featherston, W. M. Noon.
9.	
What Repairs, and How Can they be Safely Made, to Metal and Wooden Spans Without the Use of False-work	F. S. Edinger, B. W. Guppy, J. E. Greiner, John D. Isaacs, Walter A. Rogers, H. W. Fletcher.
10.	
Care of Iron Bridges After Erection, including Best Method of Protecting Them From Injury by Salt Water Drippings from Refrigerator cars	J. E. Greiner, B. W. Guppy, James McIntyre, T. M. Strain, A. J. Kelley, L. F. Goodale.
11.	
Turntable Construction	Onward Bates, J. B. Sheldon, D. K. Colburn, John Foreman, E. Fisher, Henry Goldmark.

EIGHTH CONVENTION, RICHMOND, VA., OCTOBER 18 AND 19, 1898.

1.	
What is the Most Economical Method of Painting Railway Bridges and Buildings, and Best Material to use	A. Montzheimer, B. F. Pickering, H. D. Cleaveland, W. A. McGonagle.
2.	
Life of Different Kinds of Timber in Bridges of Various Kinds, and Advisability of Protecting Same from the Weather	B. W. Guppy.
3.	
The Best Method of Constructing and Maintaining Highway and Farm Crossings	J. H. Markley, W. O. Eggleston, T. M. Strain, O. J. Travis.
4.	
Best Practical Sanitary Arrangement for Local Stations where there are no Water or Sewer Systems.	W. A. Rogers, J. B. Sheldon, C. H. Miller, J. McIntyre.
5.	
Best and Most Economical Plant for Pumping Water for Water Stations	A. Shane, A. S. Markley, R. L. Heflin, W. E. Smith.
6.	
Necessary and Kind of Tools for the Proper Equipment of a Gang of Bridge Men	G. J. Bishop, G. W. Hinman, M. Riney, A. Zimmerman.

7.

Best Snow Fence—Stationary and Portable	A. W. Merick, A. E. Killam, J. D. Isaacs, A. H. King.

8. Brought forward from 1897.

What Repairs and How Can They Be Safely Made to Metal and Wood Spans Without the Use of False Work	F. S. Edinger, J. E. Greiner, J. D. Isaacs, W. A. Rogers, H. W. Fletcher.

9. Brought forward from 1897.

Prevention of Fire in Railroad Buildings.....	G. W. Andrews, A. D. Schindler, W. E. Smith, S. B. Rice.

NINTH CONVENTION, DETROIT, MICH., OCTOBER 17 AND 18, 1899.

1. Brought forward from 1898.

Necessary and Kind of Tools for the Equipment of a Gang of Bridge Men.....	W. S. Danes, J. M. Staten, W. O. Eggleston, J. M. Caldwell.

2. Brought forward from 1898.

Best Snow Fence, Stationary or Portable.....	W. E. Smith, A. McNab, Geo. E. Hanks, A. W. Merrick. W. M. Noon.

3.

Best Method of Erecting Track Scales, Suspended or under Track.....	H. D. Cleveland, Wm. M. Clark, C. P. Austin, J. T. McIlwaine.

4.

Is Concrete the Most Suitable and Economical Material for Bridge Piers and Abutments and Railway Culverts and Arches?.....	W. A. Rogers.

5.

Hand *vs.* Air-riveting Power Used. Actual Cost Compared with Hand Work in the Field for the Erection of New Work and Repairing; also Drilling for Reinforcing old Spans.....	A. B. Manning, A. Shane, Geo. J Bishop, O. J. Travis, F. W. Tanner, F. S. Edinger.

6.

Most Practical and Cheapest Bumper for Yard Terminals.....	B. F. Pickering, A. A. Page, W. E. Harwig, A. E. Killam.

7.

Are Tie Plates on Bridge Ties a Benefit or a Detriment?.....	C. A. Lichty, A. Montzheimer, C. W. Vandergrift, H. W. Fletcher, F. S. Edinger, J. B. Sheldon.

1.		
Methods of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under.....	G. W. Andrews, C. C. Mallard, C. A. Lichty, C. W. Gooch, C. S. Thompson, D. Robertson.	
2.		
Passenger Platforms at Way Stations, Best Material and Cost of Same.....	J. B. Sheldon, John I. Banks, N. H. LaFountain, L. H. Wheaton, Wm. A. Fort, A. McNab.	
3.		
Slips for Ferry Boats Used for Transferring Railway Cars.....	John D. Isaacs, H. D. Cleaveland, J. H. Cummin, Charles Carr, H. Rettinghouse, J. T. Carpenter	
4.		
Best Method of Operating Turn-tables by Power....	F. E. Schall, J. E. Greiner, B. F. Pickering, Onward Bates.	
5.		
Auxiliary Coaling Stations; Best Design, Capacity, and Method of Handling Coal.....	W. A. McGonagle, G. W. Smith E. Fisher, J. P. Snow, B. F. Bond, R. B. Tweedy.	
6.		
Water Stations; Best Material for Foundations, Tanks, Substructure, Connections, Capacity, etc...	A. S. Markley, Charles Carr, W. O. Eggleston, A. J. Austin A. Shane.	
7.		
Is it Best for Railroad Companies to Erect Their Own Steel Structures, or Let the Manufacturers Erect Them?.....	O. J. Travis, F. S. Edinger, A. B. Manning, James McIntyre, A. Zimmerman.	
8.		
The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang.....	A. W. Merrick, S. S. Millener, Wm. M. Clark, A. A. Page, M. F. Cahill, W. E. Harwig, G. O. Lilly.	

ELEVENTH CONVENTION, ATLANTA, GA., OCT. 15, 16, AND 17, 1901.

1.

Auxiliary Coaling Stations; Best Designs, Capacity, and Method of Handling Coal. Brought forward from 1900	W. A. McGonagle, G. W. Smith, E. Fisher, J. P. Snow, B. F. Bond, R. B. Tweedy.

2.

Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expenses for Various Classes of Railroad Buildings	E. Fisher, R. H. Reed, J. S. Berry, J. P. Snow.

3.

Mail Cranes, First Cost, Efficiency and Maintenance of Various Styles in Use	A. S. Markley, F. Price, James Brady, G. W. Smith, D. W. Lum.

4.

Best Method of Protecting Low Overhead Structures Over Tracks from Gases and Blast of Locomotives.	G. W. Andrews, J. S. Lemond, C. M. Large, A. H. King, James T. Carpenter, E. H. R. Green, A. E. Killam.

5.

What has been the Expenses in the Use of Concrete Under Bridge Bedplates and Turn-tables in Place of Pedestal Stones, and What is the Best Form and Material for Bedplates Under Various Styles of Iron Bridges?	W. A. Rogers, Frank W. Tanner, George J. Bishop, J. H. Markley, A. McNab, George E. Hanks.

6.

Best Design and Recent Practice in Building Railroad Track Pile Driver	T. M. Strain, A. W. Merrick, Chas. C. Mallard, A. B. Manning, W. M. Noon, W. T. Powell.

7.

Best Material and Designs for Roundhouse Pits, Including Drainage and Rail Fastings	Arthur Montzheimer, E. M. Gilchrist, J. W. Taylor, James Stannard, Onward Bates.

8.

Best Materials for Wearing Surface of Roadway of Highway Bridge Floors	W. O. Eggleston, B. F. Peckering, A. B. Sheldon, C. P. Austin, Joseph M. Staten, O. J. Travis.

1.

Best False Work for Rocky Bottom in Rapid Currents Where Piles Cannot be Driven.....	John P. Canty, H. H. Eggleston, O. D. Killebrew, F. F. Lloyd, A. C. Macy, J. E. Greiner.

2.

Should Ties of Bridges be Gained so as to Leave Rail Without Camber, or Should Only a Portion of Camber Be Taken Out?.....	R. H. Reid, Onward Bates, H. D. Cleaveland, Henry Goldmark, J. E. Johnson, G. W. McGehee.

3.

In Case One Arm of an Important Metal Drawbridge Over a Deep Stream Should be Wrecked, What is the Most Expeditious Way to Restore Railway and Water Traffic?.....	John D. Isaacs, F. E. Schall, Geo. C. Nutting, W. M. Noon, A. McNab, Geo. W. Andrews.

4.

What is the Best Form of Traveler to Use in Erecting Steel Railway Bridges of Spans up to Two Hundred Feet?.....	G. W. Smith, O. J. Travis, J. P. Snow, C. W. Kelley, Joseph M. Staten, F. W. Tanner.

5.

Best Method of Protecting Solid Steel Floors of Bridges.....	A. O. Cunningham, Geo. F. Powers, D. W. Lum, Albert C. Keith, C. P. Austin, F. E. Schall.

6.

Best Plans for Small Tool Houses, Including Switchmen's and Car Repairers' Shanties, and Section, Tool, and Hand-car Houses.....	J. B. Sheldon, H. E. Holmes, W. E. Bell, Geo. Mitchell, Ed. Gagnon, C. R. Walton.

7.

Best Practical Sanitary Arrangements for Small Stations Where There Are no Water or Sewer Systems.....	J. H. Markley, F. J. Leavitt, Geo. J. Patterson, E. B. Ashby, T. J. Darracott, A. W. Merrick.

8.

Best Method of Making Annual Inspection of Bridges and Culverts, and Form of Report to be Made.....	Walter G. Berg, J. A. Dodson, C. F. Loweth, Arthur Montzheimer, A. Zimmerman, A. Shane. I. O. Walker.

9.

Water Filters, or Other Methods of Purifying Water for Engine Use.....	R. C. Sattley, J. E. Greiner, Ed. M. Gilchrist, Geo. E. Hanks, A. B. Manning, James Rogers.

10.

Best Method of Storing Fuel Oil, With Appliances for Supplying Locomotives, Including Plan of Water Stations, Showing Relative Arrangements of Fuel and Water Supply.....	C. C. Mallard, J. S. Berry, Geo. J. Bishop, William Carmichael, W. M. Clark, I. W. Evans, E. Fisher.

11.

What Has Been the Experience in the Use of Concrete Under Bridge Bed-plates and Turn-tables in Place of Pedestal Stones, and What is the Best Form and Material for Bed-plates Under Various Styles of Iron Bridges.....	Walter A. Rogers, A. Minster, L. F. Goodale, E. H. R. Green, J. C. Hain, E. P Hawkins.

CONSTITUTION.

ARTICLE I.

NAME.

SECTION 1. This Association is known as the "Association of Railway Superintendents of Bridges and Buildings."

ARTICLE II.

OBJECT.

SECTION 1. The object of this Association shall be the mutual advancement of its members, by the acquirement of more perfect knowledge in the construction, maintenance, and repair of railroad bridges and buildings, as well as all other matters entrusted to the care of superintendents of bridges and buildings, by common discussion, interchange of ideas, reports, and investigations of its members.

ARTICLE III.

MEMBERSHIP.

SECTION 1. Any person at the head of a bridge and building department on any railroad, or a division or subdivision, and to include assistant superintendent and general foreman of any railroad, shall be eligible to membership in this Association upon application to the Secretary and the payment of $3.00 membership fee and $2.00 for one year's dues, membership to continue until written resignation is received by the Secretary, unless member has been previously expelled.

SEC. 2. Any member guilty of dishonorable conduct, or conduct unbecoming a railroad official and member of this Association, or who shall refuse to obey the chairman, or rules of this Association, may be expelled by a two-thirds vote of the members present.

ARTICLE IV.

OFFICERS.

SECTION 1. The officers of this Association shall be a president, four vice-presidents, a secretary, a treasurer, and six executive members. The executive members, together with the president, secretary, and treasurer, shall constitute the Executive Committee.

All Past-Presidents of this Association, who continue to be members, shall be entitled to be present at all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions coming before the Executive Committee and to aid said committee by their advice and counsel; but, said Past-Presidents shall not have a right to vote, nor shall their presence be requisite in order to constitute a quorum.

ARTICLE V.

DUTIES OF OFFICERS.

SECTION 1. The duties of officers shall be such as prescribed by by-laws, as pertain to officers of like character, general, or may be assigned them by the Executive Committee.

ARTICLE VI.

EXECUTIVE COMMITTEE.

SECTION 1. The Executive Committee shall exercise a general supervision over the financial and other interests of the Association, assess the amount of annual and other dues, call, prepare for, and conduct general or special meetings, make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have power to render the Association liable for any debt beyond the amount then in the treasurer's hands not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

SEC. 2. The Executive Committee shall report the proceedings of its meetings, making such reports accessible to members; it shall publish the proceedings of all meetings of the Association, subject to the approval of the Association.

SEC. 3. Two thirds of the members of the Executive Committee may call special meetings, sixty days' notice being given members by mail.

SEC. 4. Five members of the Executive Committee shall constitute a quorum for the transaction of business.

ARTICLE VII.

ELECTION OF OFFICERS AND TENURE OF OFFICE.

SECTION 1. The officers, excepting as otherwise provided, shall be elected at the regular meeting of the Association, held on third Tuesday in October of each year, and the election shall not be postponed except by unanimous consent.

PRESIDENT AND TREASURER.

SEC. 2. The president and treasurer shall be elected by ballot by a majority of votes cast, and shall hold office for one year, or until successors are elected.

VICE-PRESIDENTS AND EXECUTIVE MEMBERS.

SEC. 3. The vice-presidents shall hold office for one year and executive members for two years, four vice-presidents, and three executive members to be elected each year; provided, however, that three of the executive members be appointed by the president at the adoption of this constitution. All officers herein named to hold office until successors are chosen at next annual meeting.

SEC. 4. In the election of vice-presidents, each one shall be elected by a majority vote. Executive members will be elected in the same way, all voting to be by written ballots.

SECRETARY.

SEC. 5. A secretary shall be elected by a majority of the votes of the members present at the annual meeting. The term of office of the secretary shall be for one year, unless terminated sooner by action of the Executive Committee, two-thirds of whom may remove the secretary at any time. His compensation shall be fixed by a majority of the Executive Committee. The secretary shall also be secretary of the Executive Committee.

TREASURER.

SEC. 6. The treasurer shall be required to give bond in an amount to be fixed by the majority of the Executive Committee.

ARTICLE VIII.

COMMITTEES.

SECTION 1. At the first session of the annual meeting the president shall appoint a committee of three members, not then officers of the Association, who shall send names of nominees for officers of the Association for the ensuing year to the secretary, before the election of officers is in order, and the names shall be announced as soon as received. The election shall not be held until the day after announcement, except by unanimous consent. Nothing in this section shall be construed to prevent any members from making nominations.

AUDITING COMMITTEE.

SEC. 2. At the first session of each annual meeting there shall be appointed by the president an auditing committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the treasurer and certify as to the correctness of his accounts. Acceptance of this committee's report will be regarded as the discharge of the committee.

COMMITTEES ON SUBJECTS FOR DISCUSSION.

SEC. 3. At the annual meeting there shall be appointed by the president a committee, whose duty it shall be to prepare and report subjects for discussion and investigation at the next annual meeting. If subjects are approved by the Association, the president shall appoint a committee to report on them. It shall be the duty of the committee to receive from members questions for discussion during the time set apart for that purpose. This committee shall be the judge of whether such questions are suitable ones for discussion, and if so, report them to the Association.

COMMITTEES ON INVESTIGATION.

SEC. 4. When the committee on subjects has reported and the Association approved of the same, the president shall appoint special committees to investigate and report on said subjects and he may appoint a special committee to investigate and report on any subject which a majority of members present may approve of.

ARTICLE IX.

ANNUAL DUES.

SECTION 1. Every member shall pay to the treasurer three dollars membership fee, and shall also pay tw dollars per year in advance to defray the necessary expenses of the Association. No member being one year in arrears for dues will be entitled to vote at any election, and any member one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

ARTICLE X.

AMENDMENTS.

SECTION 1. This constitution may be amended at any regular meeting by a two-thirds vote of members present, provided that a written notice of the proposed amendment has been given at least ninety days previous to said regular meeting.

BY-LAWS.

TIME OF MEETING.

1. The regular meeting of this Association shall be held annually on the third Tuesday in October.

HOUR OF MEETING.

2. The regular hour of meeting shall be at 10 o'clock a. m.

PLACE OF MEETING.

3. The cities or places for holding the annual convention may be proposed at any regular meeting of the Association before the final adjournment. The places proposed shall be submitted to a ballot vote of the members of the Association, the city or place receiving a majority of all the votes cast to be declared the place of the next annual meeting; but if no place received a majority of all votes, then the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

QUORUM.

4. At the regular meeting of the Association, fifteen or more members shall constitute a quorum.

ORDER OF BUSINESS.

5. 1st—Calling of roll.
   2d—Reading minutes of last meeting.
   3d—Admission of new members.

4th—President's address.
5th—Reports of secretary and treasurer.
6th—Payment of annual dues.
7th—Appointment of committees.
8th—Reports of committees.
9th—Unfinished business.
10th—New business.
11th—Reading and discussion of questions propounded by members.
12th—Miscellaneous business.
13th—Election of officers.
14th—Adjournment.

DUTIES OF OFFICERS.

6. It shall be the duty of the president to call the meeting to order at the appointed time; to preside at all meetings; to announce the business before the Association, and to decide all questions of order and sign all orders drawn on the treasurer.

7. It shall be the duty of the vice-presidents, in the absence of the president, to preside at all meetings of the Association, in their order named.

8. It shall be the duty of the secretary to keep a correct record of proceedings of all meetings of this Association; to keep correct all accounts between this Association and its members; collect all moneys due the Association, and pay the same over to the treasurer and take his receipt therefor, and to perform such other duties as the Association may require.

9. It shall be the duty of the treasurer to receive and receipt to the secretary for all moneys received from him, and pay all orders authorized by the Association.

DECISIONS.

10. The votes of a majority of members present shall decide any question, motion, or resolution which shall be brought before the Association, unless otherwise provided.

DISCUSSIONS.

11. All discussions shall be governed by Roberts' Rules of Order.

DIRECTORY OF MEMBERS.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

OCTOBER, 1902.

ALEXANDER, W. E., Bangor & Aroostook R. R., Houlton, Maine.
ALEXANDER, AMOS, Minn., St. P. & S. Ste. M. Ry., Minneapolis, Minn.
ANDERSON, J. W., Cin., Hamilton & Dayton Ry., Chillicothe, Ohio.
ANDREWS, GEORGE W., Philadelphia Div., B. & O. R. R., Baltimore, Md., 16 Hollins St.
ANDREWS, O. H., St. Jo. & G. I. & K. C. Ry., St. Joseph, Mo.
AUSTIN, CYRUS P., B. & M. R. R., Medford, Mass.
AUSTIN, A. J., M., K. & T. Ry., St. Louis, Mo.
ASHBY, E. B., Engr., M. of W. L. V. R. R., So. Bethlehem, Pa.
BATES, ONWARD, C. E., 1283 Manhatten Building, Chicago, Ill.
BANKS, JOHN I., N. Y. C. & H. R. R. R., 138th St. station, New York City.
BARRINGTON, EDWARD, Tierra Blanca, Vera Cruz, Mexico.
BEAHAM, WILLARD, C. & N. W. Ry., Winona, Minn.
BELL, W. E., Plant System, Thomasville, Ga.
BERG, WALTER G., Lehigh Valley Ry., 261 West 52d St., New York City.
BERRY, J. S., S. T. S. W. Ry., Tyler, Texas.
BERRY, WILLIAM, San Antonia & Arkansas Pass Ry., Yoakum, Texas.
BISHOP, GEORGE J., C., R. I. & P. Ry., Topeka, Kansas.
BOND, B. F., Chief Engr., Jacksonville & St. Louis Ry., Jacksonville, Ill.
BRADY, JAMES, Chicago, Rock Island & Pacific Ry., Davenport, Ia.
BRUCE, ROBERT J., P., C., C. & St. L. Ry., Logansport, Ind.
CALDWELL, J. M., Chicago, Ind. & Louisville R. R., Lafayette, Ind.
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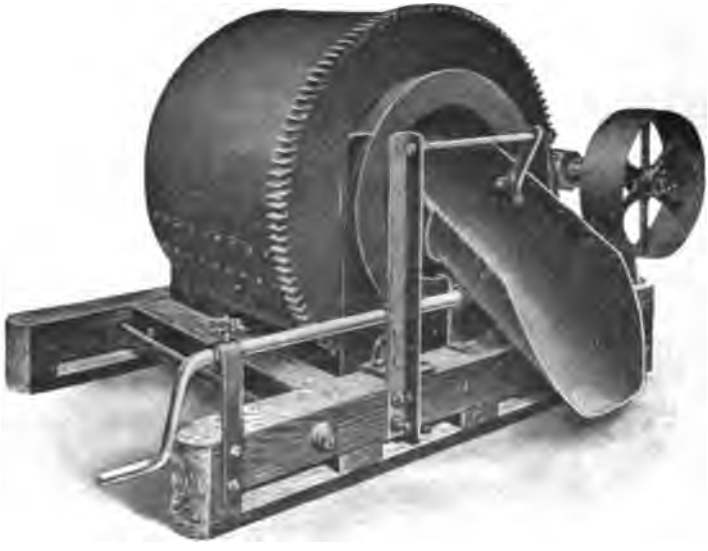

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Boston & Maine Railroad, Medford, Mass.

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A. E. KILLAM . . . . . Moncton, N. B.
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Wabash Railroad.

B. F. PICKERING . . . . . Sanbornville, N. H.
Boston & Maine Railroad.

COMMITTEES FOR 1903-1904.

COMMITTEES ON SUBJECTS FOR REPORT AND DISCUSSION.

I. What is the best form of traveler to use in erecting steel railway bridges of spans up to 200 feet?

G. W. Smith, Div. Erecting Mgr., American Bridge Co., Monadnock Block, Chicago, Ill., Chairman.
Moses Burpee, B. & A. R. R., Houlton, Me.
Geo. J. Bishop, Grand Trunk Ry., Durand, Mich.
A. O. Cunningham, Wabash R. R., St. Louis, Mo.
J. C. Hain, C., M. & St. P. Ry., Chicago, Ill.
I. F. Stern, C. & N. W. Ry., Chicago, Ill.

II. What has been the experience in the use of concrete under bridge bed-plates and turn-tables in place of pedestal stones, and what is the best form and material for bed-plates under various styles of iron bridges?

C. F. Loweth, Engr. and Supt. B. & B., C., M. & St. P. Ry., Chicago, Ill., Chairman.
T. M. Strain, Wabash Ry., Springfield, Ill.
J. E. Johnson, N. Y. C. & H. R. R. R., Grand Cent. Sta., N. Y. City.
A. Minster, C. G. W. Ry., St. Paul, Minn.
D. W. Lum, Southern Ry., Washington, D. C.
J. P. Snow, B. & M. R. R., Boston, Mass.

III. Best method of caring for trestles while being filled.

A. H. King, Supt. B. & B., Oregon Short Line, Pocatello, Idaho, Chairman.
J. B. Sheldon, N. Y., N. H. & H. R. R., Providence, R. I.
H. D. Cleaveland, P., B. & L. E. R. R., Greenville, Pa.
A. J. Hart, C., M. & St. P. Ry., Minneapolis, Minn.
F. Ingalls, Nor. Pac. Ry., Jamestown, N. D.
J. S. Lemond, Southern Ry., Atlanta, Ga.

IV. Best forms of construction for engine houses.

A. W. Merrick, Div. Engr., C. & N. W. Ry., Eagle Grove, Ia., Chairman.
L. H. Wheaton, The Coast Ry. of Nova Scotia, Yarmouth, N. S.
R. L. Heflin, Lehigh Valley R. R., Sayre, Pa.
C. W. Kelly, C. & N. W. Ry., Boone, Iowa.
C. C. Mallard, Southern Pacific Ry., Algiers, La.
A. B. Manning, M. K. & T. Ry., Parsons, Kan.

V. Best methods of filling ice-houses and conveying ice to refrigerator cars.

T. J. Carpenter, St. L. Div., Supt. B. & B., Southern Ry., Princeton, Ind., Chairman.
F. L. Burrell, C. & N. W. Ry., Fremont, Neb.
John P. Canty, B. & M. R. R., Fitchburg, Mass.
A. McNab, Pere Marquette R. R., Holland, Mich.

C. M. Large, Erie & Pittsburg R. R., Jamestown, Pa.
G. Larson, C., St. P., M. & O. Ry., Spooner, Wis.

VI. Best methods of filling track water tanks automatically.

E. B. Ashby, Engr. M. of W., Lehigh Valley R. R., So. Bethlehem, Pa., Chairman.
Willard Beahan, C. & N. W. Ry., Winona, Minn.
C. H. Miller, C., C., C. & St. L. Ry., Cleveland, Ohio.
Thos. S. Leake, Ill. Cent. R. R.,Chicago, Ill.
F. E. Schall, Lehigh Valley R. R., So. Bethlehem, Pa.
L. F. Price, Plant System, Waycross, Ga.

VII. Steam hammers versus drop hammers for pile-drivers.

O. J. Travis, Supt. B. & B., Col. & So. Ry., Denver, Col., Chairman.
R. H. Reid, L. S. & M. S. Ry., Cleveland, Ohio.
N. H. LaFountain, C., M. & St. P. Ry., Marion, Ia.
Frank J. Leavitt, B. & M. R. R., Sanbornville, N. H.
G. O. Lilly, I. C. R. R., Carbondale. Ill.
H. Rettinghouse, C. & N. W. Ry., Kaukauna, Wis.

VIII. Best form of construction for docks and wharves.

John D. Isaacs, Asst. Engr. M. of W., So. Pac. Ry., San Francisco, Cal., Chairman.
W. A. McGonagle, D., M. & N. R. R., Duluth, Minn.
Henry Goldmark, C. P. R. R., Montreal, Can.
G. J. Klump, N. Y. C. & H. R. R. R., Rochester, N. Y.
R. B. Tweedy, Wis. Cent. R. R., Milwaukee, Wis.
G. F. Powers, C., L. S. & E. Ry., South Chicago, Ill.

IX. Best record forms for buildings, water tanks, etc.

B. J. Sweatt, Div. Engr., C. & N. W. Ry., Boone, Ia., Chairman.
B. F. Pickering, B. & M. R. R., Sanbornville, N. H.
A. Shane, T., St. L. & K. C. R. R., Frankfort, Ind.
I. O. Walker, N. C. & St. L. R. R., Paducah, Ky.
J. F. White, C., H. & D. Ry., Hamilton, Ohio.
Wm. E. Harwig, Lehigh Valley R. R., Phillipsburg, N. J.

X. Best freight and roundhouse doors, and fittings for same.

John I. Banks, N. Y. C. & H. R. R. R., 138th St. Station, New York City, Chairman.
James McIntyre, Erie R. R., Cleveland, Ohio.
R. K. Ross, C. & G. T. Ry., Durand, Mich.
Ed. M. Gilchrist, K. & W. & C. B. & K. C. R. R., Centerville, Ia.
G. W. Walker, Southern Ry., Alexandria, Va.

XI. Best methods for preserving timber and piles in structures.

Wm. F. Steffens, Asst. Engr., N. Y. C. & H. R. R. R., No. 5 Vanderbilt Ave., New York City, Chairman.
John D. Isaacs, Southern Pacific Ry., San Francisco, Cal.
Geo. A. Mountain, Canada Atlantic Ry., Ottawa, Can.
E. Loughery, Tex. & Pac. Ry., Marshall, Tex.
C. C. Witt, C. & N. W. Ry., Chicago, Ill.
B. F. Bond, Jacksonville & St. Louis R. R., Jacksonville, Ill.

XII. Best methods of protecting low overhead structures over tracks from gases and blast of locomotives.

B. W. Guppy, Br. Engr., Maine Cent. R. R., Portland, Me., Chairman.
Grosvenor Aldrich, N. Y., N. H. & H. R. R., Readville, Mass.
F. F. Lloyd, Southern Pac. Ry., Oakland Pier, Cal.
Robt. J. Bruce, P., C., C. & St. L. Ry., Logansport, Ind.
W. M. Clark, B. & O. R. R., Warren, Ohio.
J. S. Berry, S. T. S. W. Ry., Tyler, Tex.

Paper entitled "Cleanliness of Station Grounds and Buildings."

J. H. Markley, T. P. & W. Ry., Peoria, Ill.

COMMITTEE ON SELECTION OF SUBJECTS.

W. A. McGonagle, D., M. & N. R. R., Duluth, Minn., Chairman.
A. E. Killam, Intercolonial Ry., Moncton, N. B.
C. W. Vandergrift, C. & O. Ry., Alderson, W. Va.
D. C. Zook, Penn. Lines West of Pittsburg, Fort Wayne, Ind.
H. M. Tripp, C. & N. W. Ry., Chicago, Ill.
A. E. Doucet, Q. & L. St. J. Ry., Quebec, Can.
Jas. McIntire, Erie R. R., Central Depot, Cleveland, Ohio.
H. W. Fletcher, 2376 California Ave., Alleghany, Pa.

COMMITTEE ON APPLICATIONS FOR MEMBERSHIP.

B. F. Pickering, B. & M. R. R., Sanbornville, N. H., Chairman.
J. H. Markley, T. P. & W. Ry., Peoria, Ill.
W. S. Danes, Wabash Ry., 102 Ewing St., Peru, Ind.
W. E. Alexander, B. & A. Ry, Houlton, Me.
F. S. Edinger, So. Pac. Ry., San Francisco, Cal.
A. W. Merrick, C. & N. W. Ry., Eagle Grove, Ia.

COMMITTEE ON SOLICITING NEW MEMBERS.

C. A. Lichty, C. & N. W. Ry., Fond du Lac, Wis., Chairman.
D. A. Shope, A., T. & S. F. Ry., Winslow, Arizona.
H. A. Horning, M. C. Ry., Niles, Mich.
Jas. Brady, C., R. I. & P. Ry., Davenport, Ia.
Wm. Reed, Jr., Ill. Cent. Ry., Chicago, Ill.
W. E. Smith, C., M. & St. P. Ry., 752 Augusta St., Chicago, Ill.
H. H. Eggleston, Central Ind. Ry., Anderson, Ind.
J. O. Thorn, C., B. & Q. Ry., Beardstown, Ill.

COMMITTEE ON RELIEF.

Jas. Stannard, Wabash Ry., Moberly, Mo., Chairman.
M. Riney, C. & N. W. Ry., Baraboo, Wis.
Moses Burpee, B. & A. Ry., Houlton, Me.
E. B. Ashby, Lehigh Valley R. R., So. Bethlehem, Pa.
John D. Isaacs, So. Pac. Ry., San Francisco, Cal.
W. M. Noon, D., S. S. & A. Ry., Marquette, Mich.

COMMITTEE ON ENTERTAINMENTS.

A. S. Markley, C. & E. I. Ry., Danville, Ill., Chairman.
R. C. Sattley, C. & N. W. Ry., Chicago, Ill.

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W. G. Berg, Lehigh Valley R. R., New York City.

COMMITTEE ON BADGES.

J. H. Cummin, Long Island R. R., Jamaica, N. Y.

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Proceedings of the Thirteenth Annual Convention

OF THE

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

HELD IN QUEBEC, CANADA, OCTOBER 20, 21, AND 22, 1903.

MORNING SESSION.

TUESDAY, October 20, 1903.

The Convention was called to order by the president, Mr. B. F. Pickering, at 10:30 o'clock a. m., Tuesday, October 20, 1903, in one of the large parlors of the Chateau De Frontenac Hotel, Quebec City, Quebec, Canada.

President.—If you will please give us your attention, as the time has come when we must call this meeting to order, and inasmuch as we cannot hope for success in the legitimate business of life without the blessing of the Almighty, we will call upon our member, Mr. Carpenter, to open our meeting with prayer.

Prayer was then offered by Mr. Carpenter.

President.—I will announce that I have appointed our worthy member, Mr. C. A. Lichty, as our assistant secretary for this meeting, and I am also pleased to announce that while we have met here in this beautiful city for this, our thirteenth annual Convention, that we have to welcome us to the city the pro-mayor, Mr. Pfeiffer, and I am sure we will all be pleased to hear from him in some brief remarks.

Mr. A. E. Pfeiffer, pro-mayor of the city of Quebec.—Ladies and gentlemen, the duty as well as pleasure devolves upon me this morning, in the absence of our worthy magistrate, the mayor of the city, to welcome you to this old and historical city

of Quebec. It is my only regret that some more emphatic demonstration should not have been tendered you, but I assure you that I heartily express the feelings of cordiality and good friendship of all of our citizens in welcoming you here. Quebec I am sure is known even to you gentlemen as a wide-open town as regards hospitality, and we sincerely trust your visit among us will be productive of pleasure and of pleasing and lasting recollections. I would invite you to visit our public buildings, and the sites of interest in and around our famous city, and again I extend to you a most cordial welcome. (Applause.)

President.—I am sure we all appreciate the greeting that we have received here in Quebec, but in order that some one more gifted than myself in language can express our appreciation, I will call on Mr. Reid for a few remarks.

Mr. Reid.—Hon. Mr. Pfeiffer, ladies and gentlemen of the Convention: In accepting the invitation of the Honorable Mr. Pfeiffer, as the representative of the city of Quebec and the Dominion government, I am sure that I voice the feelings of the entire Convention, and not only of this Convention, but of all the American people, and it is with a feeling of good fellowship and friendship that I assure you we are glad to be here. Our welcome on arriving in Montreal was spontaneous, arrangements for our pleasure and instruction were very pleasantly carried out, and we were very pleasantly entertained. In regard to the arrangements here in Quebec, everything indicates that we are heartily welcome, and we appreciate the welcome you have extended and the efforts of the people of both nations to build up and strengthen the friendship between two of the greatest nations on the earth, and the two who have made the most progress in life (applause), who have done most to carry out Christianity, and it seems to me that we should be one nation. Again, I say that it is with pleasure that we come to-day to Quebec to accept the hospitality of the people, the government, and of all. (Applause.)

President.—I think we can all heartily agree with what has been said, and especially wherein our brother refers to the two great nations, that it should be one nation, and I think we all heartily indorse his opinion. (Applause.)

Mr. Killam, alias "Johnnie Bull."—Yes, we will take you in. (Laughter.)

President.—We appreciate the kindness and loyalty of Brother Killam, but we have something back of that: you know, we, a long time ago, adopted Mr. Killam as a Yankee, and so he can only return the courtesy back to us when we come on his soil.

President.—Now we will proceed to business, and I want to make a statement, and one which I am liable to make several times more, but will ask that you bear with me, as it is the president's privilege to talk all he can, you know; but I want to say that in all of our deliberations, and in answering names in the calling of the roll, etc., I would especially request that the members speak plainly and clearly. Some of us, perhaps, are not used to talking in public very much, and so we might be afraid of the sound of our own voice, but in all of our deliberations there will be nothing but what you will, every one, want to hear, and we cannot hear what you say unless you speak distinct and plain, and I shall reiterate this request many times, perhaps. We will now listen to the calling of the roll of membership.

Secretary Patterson then called the roll, and the following members responded:

ROLL-CALL.

PRESENT.

ALEXANDER, W. E., B. & A. R. R., Houlton, Me.
AUSTIN, C. P., B. & M. R. R., Medford, Mass.
ASHLEY, E. B., L. V. R. R., So. Bethlehem, Pa.
BANKS, JOHN I., N. Y. C. & H. R. R. R., New York City.
CANTY, JOHN P., B. & M. R. R., Fitchburg, Mass.
CARPENTER, J. T., Southern Ry., Princeton, Ind.
CUNNINGHAM, A. O., Wabash R. R., St. Louis, Mo.
EDINGER, F. S., So. Pac. Ry., San Francisco, Cal.
EGGLESTON, H. H., C. I. Ry., Anderson, Ind.
GOLDMARK, HENRY, C. P. R., Montreal.
HAWKS, GEO. E., F. & P. M. Ry., E. Saginaw, Mich.
INGALLS, F., N. Pac. Ry., Jamestown, N. D.
KILLAM, A. E., Intercolonial Ry., Moncton, N. B.
LARGE, C. M., Penn. R. R., Jamestown, Pa.
LICHTY, C. A., C. & N. W. Ry., Fond du Lac, Wis.

MARKLEY, A. S., C. & E. I. R. R., Danville, Ill.
MARKLEY, J. H., T., P. & W. Ry., Peoria, Ill.
MCINTYRE, JAMES, Erie R. R., Cleveland, O.
MCNAB, A., P. M. Ry., Holland, Mich.
MERRICK, A. W., C. & N. W. Ry., Eagle Grove, Ia.
MILLER, A. F., 38 W. Van Buren St., Chicago, Ill.
MONTZHEIMER, A. E., J. & E. R. R., Joliet, Ill.
MOUNTFORT, A., B. & M. R. R., Nashua, N. H.
NOON, W. M., D., S. S. & A. Ry., Marquette, Mich.
PAGE, A. A., B. & M. R. R., Boston, Mass.
PATTERSON, S. F., B. & M. R. R., Concord, N. H.
PICKERING, B. F., B. & M. R. R., Sanbornville, N. H.
POWERS, GEO. F., C., L. S. & E. Ry., Joliet, Ill.
REID, R. H., L. S. & M. S. Ry., Cleveland, O.
RETTINGHOUSE, H., C. & N. W. Ry., Kaukauna, Wis.
ROSS, R. K., C. & G. T. Ry., Iona, Mich.
SHELDON, J. B., N. Y., N. H. & H. R. R., Providence, R. I.
SHOPE, D. A., A. T. & S. F. R. R., Winslow, Ariz.
SNOW, J. P., B. & M. R. R., Boston, Mass.
SOLES, G. H., P. & L. E. R. R., Pittsburg, Pa.
STANNARD, JAMES, Wabash R. R., Moberly, Mo.
SWEATT, B. J., C. & N. W. Ry., Boone, Ia.
VANDERGRIFT, C. W., C. & O. Ry., Alderson, W. Va.
ZOOK, D. C., Penn. Ry., Ft. Wayne, Ind.

Secretary Patterson.—The list of life members is as follows: Holland W. Fletcher and N. W. Thompson.

Mr. Fletcher responded to his name.

President.—I am sorry to say our worthy treasurer has passed away.

The following applicants for membership, subsequently elected, were also present:

ANDERSON, L. J., C. & N. W. Ry., Escanaba, Mich.
ALDRICH, GROSVENOR, N. Y., N. H. & H. R. R., Readville, Mass.
BURRELL, F. L., C. & N. W. Ry., Fremont, Neb.
BURPEE, MOSES, B. & A. R. R., Houlton, Me.
BURPEE, T. C., Intercolonial Ry., Moncton, N. B.
CRANE, HENRY, C. & N. W. Ry., Janesville, Wis.
DOUCET, A. E., Q. & L. St. J. Ry., Quebec.
FINDLEY, A., G. T. Ry., Montreal.
HORNING, HENRY A., Mich. Cent. R. R., Niles, Mich.
HALSEY, W. C., C. & N. W. Ry., Eagle Grove, Ia.
LOUGHNANE, GEO., C. & N. W. Ry., Mason City, Ia.
MILLS, R. P., N. Y. C. & H. R. R. R., Mott Haven, N. Y.
MORRILL, H. P., C. & N. W. Ry., Madison, Wis.

MOUNTAIN, GEO. A., Canada Atlantic Ry., Ottawa.
MCGRATH, H. J., Intercolonial Ry., Moncton, N. B.
MCLEAN, NEIL, C. & E. R. R., Huntington, Ind.
MCKENZIE, W. B., Intercolonial Ry., Moncton, N. B.
OSGOOD, CLEON S., P. & R. F. R. R., Rumford Falls, Me.
PATTON, A. E., G. T. Ry., Montreal.
PENWELL, John N., L. E. & W. Ry., Tipton, Ind.
PHILLIPS, HENRY W., N. Y., N. H. & H. R. R., So. Braintree, Mass.
STERN, I. F., C. & N. W. Ry., Chicago, Ill.
STEFFENS, WM. F., N. Y. C. & H. R. R. R., New York City.
TRIPPE, H. M., C. & N. W. Ry., Chicago.
WALDEN, W. D., C. & N. W. Ry., Clinton, Ia.
WITT, C. C., C. & N. W. Ry., Chicago, Ill.

President.—We will now listen to the report of the Committee on Applications for Membership. Mr. A. S. Markley is chairman of the committee, and I will call on him for the report.

Mr. A. S. Markley.—I have the pleasure to report that we have more new members this year than we ever had before in the history of our Association, which is, of course, due to the diligent work of our membership committee; you all know who that is. We have fifty new members to report on.

REPORT OF COMMITTEE ON APPLICATIONS.

The following applicants are recommended for membership in the Association:

F. L. BURRELL, Superintendent Bridges and Buildings, Chicago & North Western Railway, Fremont, Neb.

I. F. STERN, General Bridge Inspector, Chicago & North Western Railway, Chicago, Ill.

H. M. TRIPPE, Assistant Bridge Inspector, Chicago & North Western Railway, Chicago, Ill.

L. J. ANDERSON, Superintendent Bridges and Buildings, Chicago & North Western Railway, Escanaba, Mich.

GEO. LOUGHNANE, Superintendent of Bridges and Buildings, Chicago & North Western Railway, Mason City, Ia.

W. D. WALDEN, Superintendent Bridges and Buildings, Chicago & North Western Railway, Clinton, Ia.

H. A. WALDEN, Assistant Superintendent Bridges and Buildings, Chicago & North Western Railway, Boone, Ia.

C. C. WITT, Chief Draftsman, Chicago & North Western Railway, Chicago, Ill.

W. C. HALSEY, Superintendent Bridges and Buildings, Chicago & North Western Railway, Eagle Grove, Ia.

H. P. MORRILL AND WIFE, Superintendent of Bridges and Buildings, Chicago & North Western Railway, Madison, Wis.

HENRY CRANE AND WIFE, Superintendent of Bridges and Buildings, Chicago & North Western Railway, Janesville, Wis.

A. FINDLEY, Master Carpenter, Grand Trunk Railway, Montreal.

WM. F. STEFFENS, Assistant Engineer, New York Central & Hudson River Railway, 5 Vanderbilt Ave., New York City.

MOSES BURPEE, Chief Engineer, Boston & Albany Railway, Houlton, Me.

T. C. BURPEE, Engineer Maintainance of Way, Intercolonial Railway, Moncton, N. B.

GROSVENOR ALDRICH, New York, New Haven & Hartford Railway, Readville, Mass.

K. S. HULL, Nevada Central & Santa Fe Railway, Beaumont, Tex.

P. SWENSON, Minneapolis, St. Paul & Sault Ste Marie Railway, Minneapolis, Minn.

C. N. MOUSARRATT, Engineer of Bridges, Canadian Pacific Railway, Montreal.

F. P. GUTELIUS, Engineer of Maintainance of Way, Canadian Pacific Railway, Montreal.

I. H. WHITE, Chief Engineer, Halifax & South Western Railway, Bridgewater, N. S.

W. S. DAWLEY, Chief Engineer, Chicago & Eastern Illinois Railway, Chicago.

WM. F. TYE, Assistant Chief Engineer, Canadian Pacific Railway, Montreal.

GEO. A. MOUNTAIN, Chief Engineer, Canada Atlantic Railway, Ottawa.

PHELPS JOHNSON, Manager Dominion Bridge Co. System, Windsor Hotel, Montreal.

E. C. SPAULDING, Superintendent Bridges and Buildings, Boston & Maine Railroad, St. Johnsbury, Vt.

HUGH JARDINE, Engineer, Intercolonial Railway, Moncton, N. B.

THOS. SEFTON, Superintendent Bridge Erection, Intercolonial Railway, Moncton, N. B.

JOHN N. PENWELL, Supervisor Bridges and Buildings, L. E. & W. Railway, Tipton, Ind.

H. J. MCGRATH, Inspector of Works, Intercolonial Railway, Moncton, N. B.

HENRY W. PHILLIPS, Supervisor Bridges and Buildings, New York, New Haven & Hartford Railway, So. Braintree, Mass.

R. M. DRAKE, Engineer's Assistant, Southern Pacific Railway, San Francisco.

R. J. MCKEE, Superintendent Bridges and Buildings, Illinois Central Railroad, Clinton, Ill.

WM. A. LYDSTON, Boston & Maine Railroad, Salem, Mass.

HENRY A. HORNING, Supervisor Bridges and Buildings, Michigan Central Railroad, Niles, Mich.

EBENEZER BROWN, Master Bridges and Buildings, Grand Trunk Railway, Allandale, Ont.

WM. A. DWYER, Master Carpenter, Erie Railroad, Salamanca, N. Y.

W. H. WILKINSON, Bridge Inspector, Erie Railroad, Elmira, N. Y.

HENRY C. THOMPSON, Supervisor Bridges and Buildings, New York Central & Hudson River Railroad, Weehawken, N. J.

A. C. SELIG, Assistant Engineer, Intercolonial Railway, Moncton, N. B.

J. F. PARKER, General Foreman Bridges and Buildings, Santa Fe Railroad, San Benardino, Cal.

NEIL MCLEAN, Master Carpenter, Cincinnati & Evansville Railroad, Huntington, Ind.

JOHN E. BARRETT, Superintendent Tracks and Bridges and Buildings, Lehigh & Hudson River Railway, Warwick, N. Y.

CHAS. C. BATTEY, Supervisor Bridges and Buildings, Boston & Maine Railroad, Springfield, Mass.

CLEON S. OSGOOD, Road Master, Portland & Rumford Falls Railway, Rumford Falls, Me.

F. L. PARK, General Foreman Bridges and Buildings, Chicago, Rock Island & Pacific Railway, Topeka, Kan.

A. E. PATTON, Assistant Master Bridges and Buildings, Grand Trunk Railway, Montreal.

A. E. DOUCET, Chief Engineer, Q. & L. St. John Railway, Quebec.

W. B. MCKENZIE, Chief Engineer, Intercolonial Railway, Moncton, N. B.

R. P. MILLS, Superintendent Bridges and Buildings, New York Central & Hudson River Railroad, 138th St., Mott Haven, N. Y.

A. S. MARKLEY,
W. S. DANES,
GEO. E. HANKS,
C. M. LARGE,
Committee on Applications.

Mr. Ingalls.—I move that the secretary be authorized to cast one vote for all these new members.

Mr. Stannard.—I second that motion.

President.—Has any one any objections to that arrangement? It requires the unanimous consent of this body, you understand. If not, I will call on our worthy secretary to cast a ballot as moved by Mr. Ingalls.

Secretary.—Mr. President, the vote is cast.

President.—The secretary having complied with the motion,

I declare these gentlemen duly elected to membership in this organization.

President.—Now I want to say one thing more in regard to the calling of the roll; there will be other members coming in, no doubt quite a number on their way here now, and if you gentlemen that are present here this morning will just inform them as they come in to notify the secretary, so we can have a complete record of all the members that attend this Convention. I want also to say that we are not going to pass this item indefinitely, and that if there are other applications coming in through the sessions of this Convention, that we shall be glad to act on applications at any time.

Thereupon a recess was taken for the introduction of the new members, after which the meeting was again called to order, and the president delivered his annual address.

President.—Ladies and gentlemen, members and friends of the Association: It is with feelings of the greatest pleasure that I rise to address you at the opening of this, the Thirteenth Annual Convention. Were I inclined to superstition, I might say the number was a very unlucky one, but certainly I think I would be a pessimist indeed if I saw aught but the brightest augury for a successful Convention. When I consider the splendid welcome accorded us and I see the goodly number of members present, I am sure the number thirteen has been badly maligned, and I dare prophesy this Convention will be the most successful one yet held. And why should it not be? Meeting as we do here in one of the most beautiful and historic cities in America, in this magnificent hotel, and although most of us are in a foreign country, yet we have been so very cordially and hospitably received that we feel quite at home, and when we consider that of all we can possibly think that might have been done for our entertainment and comfort, not one thing is lacking, I am sure we should be most ungrateful indeed if we did not appreciate it enough to do our part toward making a pronounced success of this, our first meeting outside the domain of the United States. As I look into your earnest faces I see there is a desire for something more than glittering generalities, and, therefore, I am emboldened to speak more plainly and

specifically of several matters that seem to me of great importance to us, both individually and collectively. First I have spoken of making this Convention a pronounced success and we all realize, I think, that for this to be, we must each give it our best efforts; but I am going farther than this, and say that we must each of us give of ourselves for the success which we earnestly desire. Do we realize as we ought that to everything in which we are deeply interested we impart something of ourselves; something of our individuality; of our character; in short, something of what we are? And that unconsciously we are moulding to a greater or less extent everything and every one with whom we have earnest dealing to be something like what we are ourselves. I can perhaps better make myself understood by a simple illustration; quite frequently it has been necessary in the course of alteration and repairs on the section of road over which I have charge to take down work put up under the direction of a certain faithful employee of past years whose work was always found most strongly and substantially put together until it has become a proverb among my men when they come to such a job whose thorough workmanship and honest building make it especially hard to tear down, that this must have been one of Uncle Joe's jobs. Now if this man in his humble way imparted so much of his honest personality to the work he did that it should be so easily recognized in after years, do we realize the great possibility before us of imparting something of ourselves, of our character, not only to the work we are engaged in, but also to the men directly under our charge. If we do realize this, I am sure we shall all be more earnest and more zealous to attain for ourselves the highest possible achievement of knowledge, of wisdom, of truth, of those qualities of mind and heart that shall enable us to build for ourselves a character that shall not only give us position and influence in the world to-day, but shall help us in after life, and shall be a rock of strength long after our activities have ceased. It might seem to many who knew the already high character of this Association in its individual membership unnecessary to urge a still higher standard, but I personally feel that with one of old I can say, "I count not myself to have

apprehended," but with the meagre knowledge already attained I would press on with eager feet to higher attainments along the same line. Therefore, I would give you as the very best possible I can conceive as a fitting acknowledgment of the great honor you have conferred on me as the greatest requirement and surest promise of success for this Association the highest possible ideal of personal character and integrity. The legitimate fruitage of such noble lives will be a still keener desire for knowledge, coupled with broader philanthropy in the diffusing of that knowledge gained by our own personal application and experience. So shall we be led to go out and tell other men of the great benefit to be received from membership in this Association, thereby increasing our membership constantly. We shall also be better able to appreciate these benefits ourselves and shall be the more ready to take up the arduous work of committee investigation and reports and shall the more cheerfully assist these committees in their search for information on the various subjects of interest and importance which we shall take up from time to time, thus enabling them to make more comprehensive and complete reports adding very greatly to the value of the work we take up, until our published Proceedings shall become the standard for information in the bridge and building department for every progressive railroad official, not only in America, but for the whole world as well. This may seem like a very great undertaking and to some may seem even impossible, and I am quite free to confess that for a few men this might be well nigh impossible, but I am quite sure that even this high ideal may be realized by thoroughly organized and united individual effort. But to accomplish this, each member must feel something of responsibility in the matter and do his best. The trouble seems to me to be that most of us think we can do so little that we neglect to do what we might toward this great end. I once read a poem, the words of which I have forgotten, but the thought was this, that there are but two classes of people in the world, those who lift and those who lean, and I am sure that none of us wish to belong to the latter class. There is no member of this Association so humble but that he can add something to the fund of knowledge

gained by practical experience which makes our publications so valuable and so sought after by practical progressive men. Let us not think then that because we are not giants that we cannot help to lift our Association into this exalted position, but let us rather go forward to attain all the knowledge possible. Then let us freely impart that knowledge to others, especially to the various committees appointed each year on the subjects chosen for investigation. I am very much pleased to see so many good men applying for membership and I desire to say to these new members that we are very glad to welcome them for service, for we propose to put in the hardest kind of work during the sessions of this convention, and we want every one to give us the best he can from his own experience on the subjects up for discussion, and then we propose to play just as hard for a short time. But as we shall separate and go to our various posts of duty, let us each bear with us this thought that during all the weeks of the coming year we will have the good of this Association on our minds and will do all in our power towards the attainment of the high ideals we have herein set before us.

I am very sorry to say that the Death Angel has invaded our ranks during the past year, and the old adage has again proved true that he loves a shining mark, but we are glad to know that our brothers who have gone before us gave ample evidence during their lives with us of their faith in our high ideals and by their earnest lives have helped us towards the attainment of these ideals.

I have perhaps already wearied your patience, but I feel deeply the great importance of these things, especially from the standpoint of individual character and effort and am exceedingly anxious that we shall not be content with the grand work accomplished in the past to the extent of relaxing our efforts, but rather that we shall go forward to greatly increased effort along these lines that have proved so successful in the past.

I desire to thank you all for the good work you have done this year and to entreat that though the obstacles in our pathway may be many and great, that we may press on toward that

high standard of individual character and effort that shall make this Association most prosperous and shall enable us to achieve unqualified success. (Applause.)

President.—We will pass the fifth item of business and take up the sixth item, the payment of annual dues and distribution of badges. At the meeting of the Executive Committee held last fall, the subject of badges for the wives of members came up. The Executive Committee has decided that each member shall have a badge for himself and also provided a badge for each of the lady members, or rather the wife of each member, similar to our own, only gold instead of silver. Please understand that we also have guest badges, as in former years, which will be distributed to every guest attending our Convention, but these special badges I mention are simply for the wives of members only. Each member is entitled to one for his wife; if he has n't a wife, he is not entitled to one; you see we are putting a premium on married members, which is an inducement for every good member to get married. We will now take a recess and I will ask the members to come forward to pay their annual dues and to receive these badges, after which the ladies will be excused if they so desire. The assistant secretary will check the names as the badges are given out to each member for his wife and to each guest here present we will present a guest's badge, and if there is any member here who has not a member's badge and never received one, he is entitled to one, or if any member has left his own at home inadvertently he can receive one for this Convention, and return it, please, to the secretary at the close of this meeting.

A recess was then taken for the payment of the annual dues and the distribution of members' badges, badges for wives of the members, and guest badges.

President.—Gentlemen, you will come to order, please, again and we will proceed with the regular business.

President.—We will pass the reading of the minutes of the last meeting. I do this because the minutes of the last meeting, or the proceedings of the last annual Convention, were issued in printed form and every member received one, so it is unnecessary to read them.

President.—We are now ready to listen to the report of the secretary.

Secretary Patterson thereupon read his annual report.

REPORT OF SECRETARY.

To the Association of Railway Superintendents of Bridges and Buildings:

GENTLEMEN: Your secretary submits the following report for the year ending October 20, 1903. The Executive Committee met in Mr. McGonagle's private car at Ely, Minn., October 20, 1902, on the trip through the Iron Range of Minnesota. On account of the length of time and the expense of the mid-year meeting, it was left with the president and chairman to attend to the necessary business by correspondence. Mr. A. E. Killam and W. E. Alexander were appointed a local committee to arrange for our next Convention at Quebec, and, in conjunction with the president, subsequently presented a programme for our Thirteenth Annual Convention. On February 22, 1903, our worthy treasurer, Mr. N. W. Thompson, was suddenly called hence. We shall miss him, he being a charter member, and always present at our Conventions. A proper memoir will be presented to you by the committee. Long may his memory remain with us. We have now on our roll 183 names and 50 applications to be acted upon to-day, and our Association is in a prosperous condition. I wish to thank our advertising patrons for their liberal support and kindly greetings; also to thank the members for their hearty co-operation and support.

FINANCIAL.

Dr.

To cash on hand at last report	$313.43
cash received for dues and new members	442.05
cash received for advertisements	900.00
cash received for sale of books and tables	39.75
	$1,695.23

Cr.

By cash paid out, for which I hold vouchers	$1,504.20
Balance in my hands	$191.03

Respectfully submitted,

S. F. PATTERSON,
Secretary.

President.—What will you do with the secretary's report?

Mr. Reid.—I move that the report be accepted as read.

Motion seconded.

President.—If no objection, the report is accepted.

President.—We will now listen to the annual report of the Executive Committee.

Annual report of the Executive Committee was thereupon read by the assistant secretary, Mr. C. A. Lichty.

ANNUAL REPORT OF EXECUTIVE COMMITTEE.

ELY, MINN., Oct. 24, 1902.

Minutes of Executive Committee Meeting held on board Mr. W. A. McGonagle's Private Car on road, Ely, Minn., Friday evening, Oct. 24, 1902.

Meeting called to order by Secretary Patterson, 8: 50 o'clock p. m. Present: J. H. Cummin, S. F. Patterson, B. F. Pickering, A. S. Markley, C. P. Austin, C. A. Lichty, J. H. Markley, W. A. McGonagle, and A. Montzheimer. In the absence of the chairman, Mr. Pickering was called to the chair. On motion of Mr. Cummin, Mr. W. G. Berg was appointed an editing committee, to act in conjunction with the secretary in preparing matter for the proceedings of our twelfth annual convention. On motion of Mr. McGonagle, Mr. A. E. Killam and W. E. Alexander were appointed a local committee on arrangements for our next Convention. Mr. Cummin moved that 1,000 copies of the proceedings be printed. Motion carried. On regular motion, made the price of proceedings same as in the past, 75 cents per copy. On motion of Mr. Cummin (after discussion), decided that the whole matter of dispensing with the mid-year Executive Committee meeting and transacting the necessary business of the meeting by correspondence instead, be left to the president and chairman of the Executive Committee. Minutes of meeting read and approved. Adjourned, 10: 07 p. m.

MONTREAL, October 19, 1903.

Minutes of Meeting of the Executive Committee held at the Queen's Hotel, Montreal, Canada, 7 o'clock p. m., Monday, October 19, 1903.

Members present: President B. F. Pickering, Secretary S. F. Patterson, James Stannard, J. H. Markley, A. S. Markley, A. Montzheimer, C. A. Lichty, and A. W. Merrick. Meeting called to order by President Pickering. Report of Secretary Patterson read by himself, showing the Association to be in a flourishing condition. On regular motion of Mr. J. H. Markley, decided that the secretary's report be accepted and referred to the Convention. Minutes of last meeting of the Executive Committee, which was held at Ely, Minn., on board Mr. McGonagle's private car, were read by Secretary Patterson. Minutes had already been approved at the last meeting. Secretary stated for information of the Executive Committee that Mr. George W. Andrews was $11 in arrears for dues, and on regular motion the secretary was instructed to again communicate with Mr. Andrews in regard to his dues, and in event that he did not pay up, that his name be dropped from the list of members, prior to the publication of the next proceedings. The secretary stated he had received resignations from the following members: Mr. N. M. Markley and Mr. G. C. Nutting, which were accepted. Moved by Mr. Lichty that meeting adjourn, subject to call of the president. Motion prevailed.

Minutes of Meeting of Executive Committee held in Frontenac Hotel, Tuesday morning, 9 : 30 o'clock, October 20, 1903.

Members present: B. F. Pickering, James Stannard, A. S. Markley, J. H. Markley, S. F. Patterson, C. P. Austin, A. W. Merrick, and C. A. Lichty. Meeting called to order by Mr. Pickering. Minutes of last meeting read and approved. Decided that official badges for wives of members of the Association be furnished to wives of members only. On regular motion, decided that the Association would pay one half

of the expense of the sleeping-car transportation for one berth for the members only for the side trip to Sydney and return. On motion of Mr. J. H. Markley, meeting adjourned *sine die*.

S. F. PATTERSON,
Secretary.

Mr. Burrill.—Mr. Chairman, I move that the report take the usual course. Motion seconded and carried.

President.—In reference to the report of the treasurer, you all know, as I said before, that our treasurer has gone to report to a Higher Court since we last met, and I would say for the information of the members that there has been no one appointed in his place, for the reason that your constitution makes no provision for filling a vacancy between the sessions of the Association. As president, when notified of the treasurer's death, I immediately looked this matter up and took legal counsel in the matter, and it was decided that there could be no legal appointment made, and so the matter has stood just there. We have, as our last report showed, $719.51, cash on hand in the treasurer's hands, and that was deposited in the bank at Fort Wayne, Ind., in the name of the treasurer of this Association, and could not be drawn except by a treasurer legally elected by this Association, and that matter will come up later on, and when we elect a treasurer he will be duly qualified to take possession of this money. A draft has been made on the treasury since the last report for $150, and $12.62 interest has been added, making a balance to turn over to the new treasurer of $582.13. This would therefore constitute the treasurer's report.

President.—The next item of business is the appointment of committees, and I find that of the committee that was appointed last year on the selection of subjects, there are not many of them present; in fact, so far there is only one member, Mr. D. C. Zook. Mr. Vandergrift is on his way here, and I had intended to have that list filled out, but I have not done so, and I will announce those later on. I will now announce the following:

NOMINATING COMMITTEE.

A. S. Markley, James Stannard, W. E. Alexander, F. S. Edinger, A. E. Killam.

AUDITING COMMITTEE.

J. P. Canty, H. Rettinghouse, H. H. Eggleston.

OBITUARY COMMITTEE.

C. M. Large, C. P. Austin, J. T. Carpenter.

COMMITTEE ON RESOLUTIONS.

A. W. Merrick, A. Mountfort, J. I. Banks, A. O. Cunningham.

President.—All those intending to take the trip to Sydney who have not yet given their names to Mr. Montzheimer will please do so as soon as possible, so plans can be made for their accommodation. I will state that the Intercolonial Railway has very kindly offered us a special train composed of five Wagner sleeping cars and two dining cars, leaving here next Saturday morning, or rather Friday night. The cars will be ready Friday night by probably ten o'clock p. m., just across the river at Levis. In order to vary the monotony of eating on the dining cars all the time, they have provided for stopping at some of the hotels for some of our meals. There are many other matters of interest in regard to this trip which will be announced later, but I want to say in regard to this train, etc., that I think it is the most liberal provision that I ever knew to be made to an association of this character, and I trust every one can go on this trip. The Intercolonial Railway extends an invitation not only to the members of this Association but to all their visiting friends. The transportation is entirely free to this Association and all visiting friends, and all that has to be paid is the sleeping car transportation.

Mr. Killam.—The mayor of Sydney, Cape Breton Island, has just wired me that he wants us to give them more time, wants twice as much time, and if we do that, it will take a little longer than originally arranged for.

Mr. Reid.—According to the circular it shows that we are to reach Montreal Wednesday evening.

Mr. Montzheimer.—I think a great many may object to lengthening the trip, and if possible I think we should get back at the time stated, which is some time Wednesday night, because so many have planned to get back home on a certain day.

President.—No doubt that can be arranged for all right. There is one of the greatest steel plants being constructed and partially in operation at Sydney that we have in the country, but no doubt it can be arranged to get back to Montreal Wednesday evening all right.

Mr. A. S. Markley.—I would like to see all the members at the close of this meeting that are on the Nominating Committee.

President.—We will hear the report of the Committee on Relief.

Report of Committee on Relief was thereupon read by Mr. Lichty.

HOTEL CHATEAU FRONTENAC,
QUEBEC, Oct. 20, 1903.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your committee appointed on Relief at our last meeting, which was held at West hotel, Minneapolis, Minn., are happy to report that during the past year there have been but few applications for relief, but your committee have received quite a number of inquiries from officials of different roads for competent men, to which your committee gave prompt attention, and are pleased to say that we have succeeded in placing several of our members in good positions.

Trusting this report will meet with the approval of our Association, the same is respectfully submitted.

JAMES STANNARD,
M. RINEY,
J. W. MORGAN,
A. MOUNTFORT,
F. S. EDINGER,
EDWARD BARRINGTON,
Committee.

Motion made to receive the report seconded and carried.

Mr. Stannard.—I move we adjourn until two o'clock.

Motion seconded and carried.

President.—We will stand adjourned until two o'clock.

AFTERNOON SESSION, TUESDAY, OCTOBER 20, 1903.

President.—Please come to order, gentlemen. You will notice that our committee on selection of subjects that was appointed last year for selecting subjects for the next year are not all present by any means, and so I will appoint additional members on that committee. It is a very important matter, the selection of subjects for investigation and discussion, and I would like to have not only these men that I am going to name on the committee serve, but would like to have every one who has any subject in mind to present it to that committee. The additional members are as follows: James T. Carpenter, H. Rettinghouse, J. P. Snow, F. S. Edinger, H. A. Horning, John H. Markley, Arthur Montzheimer. This is in addition to the present list.

President.—I would like to announce that this committee on selection of subjects will meet for conference immediately after the close of this session this afternoon, and I desire a full representation of all of the committee that are present.

President.—We will next listen to the report of the Memoir Committee.

Report thereupon read by assistant secretary, Mr. Lichty:

REPORT OF COMMITTEE ON MEMOIRS.

Your Committee on Memoirs presents herewith memoir of our deceased member, N. W. Thompson, who died February 22, 1903, at Fort Wayne, Ind.

WALTER G. BERG,
Committee.

October 10, 1903.

MEMOIR.*

NELSON W. THOMPSON.

ELECTED MEMBER	October 18, 1892.
THIRD VICE-PRESIDENT	1892-1893.
TREASURER	1896-1903.
ELECTED HONORARY LIFE MEMBER	October, 1902.
DIED	February 22, 1903.

Nelson W. Thompson was born in Orleans county, N. Y., on May 6, 1830, and died of apoplexy at Fort Wayne, Ind., February 22, 1903, at

* Memoir prepared by Walter G. Berg, from data furnished by Mr. Thompson's brother, George W. Thompson, of Grand Rapids, Mich., and from records in the Proceedings of the Association.

the age of nearly 73 years. He was apparently in perfect health, had eaten dinner, gone to the barn and cared for his horse, and afterwards returned to the house and sat down to talk with some friends who had called to visit him. Without a moment's warning, and while engaged in conversation, his head suddenly dropped and he expired.

He was buried at Osseo, Hillsdale county, Mich., in the East Hill cemetery, on the old Thompson homestead farm, which he owned There are a number of pathetic coincidences connected with Mr. Thompson's sudden death. The services were conducted in the old home that he had lived in sixty-five years previously, and he was buried within two hundred feet of the site of the old log schoolhouse he had attended as a boy. The funeral took place on February 26, 1903, the fiftieth anniversary of his wedding. Mr. Thompson had shortly before his death arranged to fit up a house on the same lot that he commenced housekeeping in after his marriage fifty years ago, and had expected to move from Fort Wayne to his new house and old home at Osseo during the spring of 1903.

Mrs. Thompson, well known to many members of the Association, owing to her almost steady attendance with her husband at our annual conventions for the last ten years, has sold the Fort Wayne property since Mr. Thompson's death and is now living in the new home at Osseo, carrying out the plans Mr. Thompson had framed prior to his death.

Mr. Thompson left, besides his wife, two brothers, George W. Thompson, a lawyer of Grand Rapids, Mich., and F. W. Thompson of Hillsdale, Mich., and a sister, Mrs. Elizabeth Lamb of Hillsdale, Mich.

Mr. Thompson's father took up land in 1836 at Osseo, township of Jefferson, Hillsdale county, Michigan, and moved his family from Adrian, N. Y., to the farm at Osseo in 1838, known later as the Thompson homestead. Mr. Thompson lived at Osseo until about thirty years ago, when he took service with the Pennsylvania company, and subsequently moved to Fort Wayne, Ind.

Mr. Thompson attended school at Adrian, and subsequently at Osseo, during the winter months in the log schoolhouse at that place. He left his father's farm when seventeen years old and worked on the Mississippi river, on the Wabash canal, and on the Erie canal. He then returned to Osseo and married Miss Nancy Orcutt, on February 26, 1853.

Mr. Thompson's railroad career started in 1859, although he used to jokingly claim that he had started railroading at the age of nine years, in 1839, when the Lake Shore Railroad was being built near his home in Hillsdale county, Mich., as he was frequently allowed to drive a cart from the pit to the dump. Starting in 1859, he worked in succession for the Lake Shore Railroad, the Fort Wayne and Bluffton Railroad, the Canada Southern Railroad, and in the construction of the bridges for the Richmond road, now known as the Grand Rapids & Indiana Railway.

After the completion of construction on this road he had charge of bridge repairs for a year, after which he took service with the Pennsylvania company as foreman of bridges, and was stationed at Valparaiso, Ind. In 1876 the office of supervisor of bridges and buildings was created on the western division of the Pennsylvania lines, northwest system, and on account of Mr. Thompson's great experience and marked ability the position was tendered to him. He accepted it and moved to Fort Wayne, Ind., and continued in this position until 1897, when, owing to his advanced age, he was retired to the position of assistant supervisor, and subsequently, in 1901, placed on the pension roll of the Pennsylvania company. He filled

the responsible position of supervisor of bridges and buildings for twenty-one years with marked ability and to the entire satisfaction of his superiors, and on account of his justice and fairness he commanded the respect and esteem of his subordinates.

Mr. Thompson was master of Star Lodge, No. 93, F. and A. M., at Hillsdale, in 1868 and 1869, and had served continuously as treasurer of the Association of Railway Superintendents of Bridges and Buildings from 1896, which position he held at the time of his decease.

Mr. Thompson was elected a member of the Association of Railway Superintendents of Bridges and Buildings at the Cincinnati convention in October, 1892, and was at the same convention elected third vice-president for the following year. After the death of our former treasurer, Mr. George M. Reid, Mr. Thompson was elected treasurer in 1896, which position he filled continuously until the time of his death. In October, 1902, he was further honored by being elected a life member of the Association.

Mr. Thompson was faithful to all duties assigned to him by the Association. He attended every convention from 1894 to 1902, namely, at Kansas City, New Orleans, Chicago, Denver, Richmond, Detroit, St. Louis, Atlanta, and Minneapolis, usually accompanied by his wife, so that their presence came to be considered as an established feature of every convention. In addition to his duties as treasurer, Mr. Thompson served repeatedly on the various committees for Auditing, Nominating, Resolutions, and Subjects for Discussion. In 1896 he served on a committee to report on "The most suitable material for roofs of buildings of all kinds." He was an *ex-officio* member of the Executive Committee from 1896 to the time of his decease.

In addition to his long continued connection with the business interests and committees of the Association, Mr. Thompson took an active interest in the discussions on technical subjects, and his views were eminently respected and received full consideration, owing to his known ability as a practical bridge and building man.

Mr. Thompson will be remembered by his friends and associates as a happy and genial companion and true gentleman in the full sense of the word. He had a strong personality, and his friendship, when found, was warm, true, and lasting. He was active and energetic throughout his railroad career, enjoyed the confidence of his railroad associates and superior officers in a marked degree, and had many warm friends in the profession.

The above partial record of Mr. Thompson's faithfulness to his railroad interests, his devotion to our Association, his practical ability, his genial manner, true merit, and sterling integrity, and his warm friendship for many members of our Association, make it difficult to embody in a brief memoir all the good points and qualifications that are due as a well-deserved tribute to the memory of a dear friend and honored associate, of whose life's work it can be truly said, "Well done, thou good and faithful servant."

President.—You have heard the report, gentlemen, what is your pleasure?

Mr. A. S. Markley.—I move that the report be received and made a part of our annual proceedings.

Mr. Stannard.—I will second that motion.

President.—The report is accepted.

President.—We will now listen to the report of the Obituary Committee.

Report read by Mr. Large:

REPORT OF OBITUARY COMMITTEE.

WHEREAS, God, in his infinite wisdom and mercy, has removed two of our members, thus severing two more links in the chain of friendship that binds us together, and reminding us of the uncertainty of human life and the certainty of death, therefore, be it

Resolved, That we as an Association sincerely mourn the loss of our beloved brothers, N. W. Thompson and W. B. Mitchell.

Resolved, That the sympathy of this Association be tendered to the widows of the deceased brothers by the Secretary, and that a copy of these resolutions be printed in full in our Proceedings.

C. M. LARGE,
C. P. AUSTIN,
J. T. CARPENTER,
Committee.

President.—You have heard the report of the Obituary Committee, what shall we do with it, gentlemen?

Moved and seconded that the report be received and printed in the Proceedings.

President.—As many as favor the motion that this report of the Obituary Committee be received and incorporated in our printed Proceedings, please so manifest by saying Aye. The motion prevails and report is accepted.

President.—The next item we will take up is the reports of Committees on Investigations. The first subject is, "Best false work for rocky bottom in rapid currents where piles cannot be driven." Mr. Canty is chairman of that committee, and if he is not present we will pass to subject number two and refer back to this later.

President.—Next is subject number two, "Should ties of bridges be gained so as to leave rail without camber, or should only a portion of camber be taken out?" Mr. Reid, I believe, has prepared a report on this, and we would like to hear from him.

Mr. Reid.—All I will say in the way of a preliminary report is, that owing to the press of business on our road and the limited time I had myself, I was unable to get a meeting of the committee, and after putting it off as long as I dared in the hope of doing so, I sent out circulars to the different mem-

bers to gather what information I could in that way. I sent out about one hundred, and received replies to about thirty, I think, and even since then I have been unable to get a meeting of the committee, but I sent out circulars to each member of the committee, stating what information I had secured in a general way, and giving my own personal views on the matter, and asked them to express their wishes, if they had different views on the subject, or to make any recommendation they chose in regard to the committee report. I received a reply from Mr. Cleaveland. His views were practically the same as those I had expressed, and the other members I have not yet heard from.

Report on subject number two was then read by Mr. Reid. (See report on subject number two.)

Mr. Reid.—In further reference to my report, I would say that there are a few letters here which I have selected from among the bunch received, and which I would like to read. You would probably not care to hear all of them.

Mr. Reid thereupon read a number of letters which pertained to his report. (See letters, to be printed as an appendix to the report.)

President.—We will now take up subject number one, "Best false work for rocky bottom in rapid currents where piles cannot be driven." Mr. Canty, the chairman, is present now.

Mr. Canty.—Gentlemen of the Association, I will not attempt to read the report; it is too long, and will take up too much time. It is all printed here, and you can read it at your pleasure. You will notice, in reading the report, that the majority of the members stated in their articles that no one particular scheme will fit all cases, and the committee arrived at the same conclusion and simply got up a paper which brought together the vital points in the reports from the different sections of the country. (See report on subject number one.)

President.—Subject number three, "In case one arm of an important metal drawbridge over a deep stream should be wrecked, what is the most expeditious way to restore

railway and water traffic?" Mr. John D. Isaacs is chairman, but the only members of this committee that I see present are Mr. Noon and Mr. McNab. Can they tell us anything about the report?

Mr. Noon.—I have not taken any active part in it, only corresponded with Mr. Isaacs in regard to it, and therefore could not say anything about it. (See report on subject number three.)

President.—I will call for report on subject number four, "What is the best form of traveler to be used in erecting steel railway bridges of spans up to two hundred feet?" Mr. Snow is the only member of the committee that I see here. Mr. Smith is chairman, but he is not present. Mr. Snow.

Mr. Snow.—I understand my name is on this committee, but I never had any communication with the chairman, consequently do not know what his mind is in the matter, and I cannot give you any report.

President.—Mr. Secretary, have you received any report on this subject number four?

Secretary.—No, sir.

President.—Number five next, "Best method of protecting solid steel floors of bridges." Mr. A. O. Cunningham of the Wabash Railroad is chairman of this committee, and we will be pleased to hear from him.

Mr. Cunningham.—The report is printed in full, but I notice that there is a mistake in the number of questions that the committee sent out. I notice only ten questions shown in the printed report, whereas there were twelve questions, and the two omissions, eleven and twelve, were due to an error on the part of my stenographer, he having omitted to enclose another sheet. The report is given in full with the exception of those two questions; however, they will be incorporated in the full report when it is printed in the Proceedings. I sent out several letters and the list of questions to members of the committee, requesting them to make any alterations they desired, and received very few letters in return from members of the committee. But one member helped me at all in the matter, and the others were too busy to help; but we got replies from our circular letters from every one we addressed a letter

to, but these replies were so varied that the committee could not come to any definite decision in regard to the matter. (See report on subject number five.)

President.—Subject number six, "Best plans for small tool houses, including switchmen's and car repairers' shanties, and section, tool, and hand-car houses," Mr. J. B. Sheldon, chairman. Mr. Sheldon, we will be glad to hear from you.

Mr. Sheldon.—Mr. President, members of the Association, in making this report, would like to state that the chairman had great difficulty in getting any response from the other members of the committee. Tried repeatedly and failed, with one exception. One of our North Western friends who was on the committee was heard from, and I will say that I was unable to get the expressed wishes of the committee. We appealed to members of the Association by sending out circulars, and received something like twenty odd replies, very few, however, had much to say about their experiments, but sent plans, which are here on exhibition, and each member can choose whatever plan suits him best. With this explanation I will submit this report, and say that the plans referred to are here on exhibition. (See report on subject number six.)

President.—Next is subject number seven, "Best practical sanitary arrangement for small stations where there is no water or sewer system," Mr. J. H. Markley, chairman.

Mr. J. H. Markley.—Mr. President and members of the Association, I have the same complaint to make as the others; have had very little or no assistance from my committee, and one member is among our friends on the North Western. I will only read the main part of the report, as I do not think that it is necessary to read the attached letters, as they will be printed in the Proceedings.

Report was thereupon read by Mr. J. H. Markley. (See report on subject number seven.)

President.—Subject number eight will be next, "Best method of making annual inspection of bridges and culverts, and form of report to be made." Mr. Walter G. Berg is chairman of this committee. Mr. Berg is unable to be present, and the only other member of this committee present is

Mr. Montzheimer; in fact, I do not see him in the hall just now. I am glad to say that we have a very full report here, and a very valuable one as well, which you would do well to consider as it comes up in the routine of our business. (See report on subject number eight.)

President.—Subject number nine, "Water filters, or other methods of purifying water for engine use." Mr. R. C. Sattley is chairman, but is not present. Mr. Hanks is the only member of the committee present. We have here a very fine report.

Mr. Swett.—I believe Mr. Rettinghouse has a letter from the chairman of that committee, Mr. Sattley.

President.—We would like to hear from Mr. Rettinghouse if he is present.

President.—As Mr. Rettinghouse is not in, we will pass to the next subject, and take this up again when he comes in. (See report on subject number nine.)

President.—The next subject will be number ten, "Best method of storing fuel oil, with appliances for supplying locomotives, including plan of water stations, showing relative arrangements of fuel and water supply." Mr. C. C. Mallard, chairman, is not present, and I do not think there is a member of the committee that is. I understand our secretary, here, has the report, but that it came too late to be printed, and I think in view of that fact it should be read. I will call upon our assistant secretary, Mr. Lichty, to read the report.

Report read by the assistant secretary. (See report on subject number ten.)

Secretary.—I received this report just about ten minutes before starting for Quebec, therefore had not time to have it printed; sorry not to have had it in season. Here are some blue prints sent in connection with this report, which are for inspection. Mr. Mallard regretted very much his inability to be present, but he is holding down a new job, and just at this time he did not feel that he could spare the time to come, and expressed a good deal of regret on that account.

President.—Subject number eleven will be the next report to take up: "What has been the experience in the use of con-

crete under bridge bed-plates and turn-tables in place of pedestal stones, and what is the best form and material for bed-plates under various styles of iron bridges," Mr. J. C. Hain, chairman.

Secretary.—I will state there is no report on subject number eleven, and I would further add that I received a communication from Mr. Hain something like two weeks ago, in which he said that up to that time he had hoped to be able to make a report, but on account of the great pressure of business he would be unable to do so, and regretted very much his inability to be with us. The assistant secretary also has a letter from Mr. Hain, which I will ask him to please read.

The assistant secretary then read a letter from Mr. Hain, saying that it was impossible for him to present a report on subject number eleven, and also expressing his regret on account of not being able to attend the Quebec convention.

President.—Gentlemen, that completes our reports for this year, and, according to our custom, we will now turn to the discussion of reports presented last year and take them up in their order. We will be glad to hear from any one who has had any experience on the subjects under discussion that was not covered in the discussion last year. The first subject for discussion that was presented last year is "Auxiliary coaling stations, best designs, capacity, and method of handling coal." Report was made by Mr. McGonagle, and it was quite largely discussed, but would like to hear anything in addition to what was presented last year. (See discussion.)

President.—The next subject which we will now take up is last year's subject number two, "Roof coverings, first cost, life, efficiency, and maintenance expense for various classes of railroad buildings." Would like to hear from some one on this; it is a very important subject. (See discussion.)

President.—If nothing more on this subject we will pass to the next subject, which will be number three, "Mail cranes, first cost, efficiency, and maintainance of various styles in use." (See discussion.)

President.—Before we adjourn this session we have some announcements to make.

President then read a letter from Mr. Z. Paquet of Quebec, Hare Point, inviting the Association to call at their large fur and glove factories, and at their departmental stores, St. Joseph's street, and wishing all the members a hearty welcome and enjoyment during their stay in Quebec.

President.—If no objection, we will now adjourn to meet at 7:30 this evening, prompt.

EVENING SESSION, TUESDAY, OCTOBER 20, 1903.

President.—Gentlemen, if you will come to order now we will proceed to business. We will take up the subjects of last year's reports for discussion, where we left off this afternoon. I find that there was no report made on the next two subjects, four and five last year, "Best method of protecting low overhead structures over tracks from gases and blast of locomotives" and "What has been the experience in the use of concrete under bridge-bed plates and turn-tables in place of pedestal stones, and what is the best form and material for bed-plates under various styles of iron bridges," respectively. There was no report and no discussion of either of these subjects.

Mr. Lichty.—There are a number of members with us, who, I think, can give us some good information on subject number four and who probably will be in a little later on, and I think if we could carry this subject number four over until later, we might get up a discussion by some of the members who have had considerable experience in this line.

President.—What action will you take in the matter, gentlemen?

Mr. Snow.—Without any report we cannot have a very interesting discussion unless we have a report to start on, and it seems to me it would be better to have those subjects which have not been formerly reported on, put in the next year's programme until they are acted upon, and decided whether or not there is anything in them. I think the subject is worthy of a good discussion, but it is a question whether it is best to discuss it without any report or wait until it is properly reported on.

Mr. Miller.—I would like to hear this subject discussed. I am interested in this subject as much as any subject on the programme. On our viaduct bridges in the city of Chicago it is a very hard matter to keep them from being eaten out by sulphur smoke. The stringers only last eight or nine years, and if there is some method of protecting or preserving them, I would like to know it.

Mr. Lichty.—Mr. Chairman, I would make a motion that we recommend to the new president of this Association that a committee be appointed and that the recommendation be made to the committee on subjects that this question be considered at the next meeting and that Mr. Miller be made chairman of that committee.

President.—You have heard the motion that this subject be referred to the committee on subjects with the recommendation that it be adopted as one of the subjects for the ensuing year, and with the further recommendation to our future president that Mr. Miller be made chairman of that committee.

Mr. Large.—I second that motion.

President.—As many as are in favor of this motion, please so manifest by saying Aye. Those opposed, Nay. The motion prevails.

Mr. Burrill.—I would say that if Mr. Miller cares to interest himself in the transactions of the last meeting of the American Society of Civil Engineers that there was a paper brought out at that meeting bearing on this subject, from which he might get some information.

President.—That disposes of subject number four of last year. The next is subject number five, "What has been the experience in the use of concrete under bridge bed-plates, etc." I will say this subject was continued over to this year. I persuaded Mr. J. C. Hain to take the chairmanship of that committee. It appears in the proceedings that the chairman is Mr. Walter G. Rogers, but it should be Mr. J. C. Hain. Mr. Rogers informed me that it would be utterly impossible for him to do the work, and Mr. Hain accepted the chairmanship about two weeks ago, but informed me it was impossible to make the report. What will you do with this subject? Do

you think it is worth while to continue it to another year? It was subject number five last year; it is subject number eleven this year.

Mr. Large.—It strikes me that this is a very important subject, and I think it would be well if we could arrange to carry it over for still another year, and get it in the proper shape. I think we ought to do so. I don't think we ought to drop such a subject as that.

Mr. Montzheimer.—I move that the subject be carried over until next year and a new committee appointed.

Mr. Fletcher.—I would second that motion, that it be carried over until next year.

President.—Gentlemen, you have heard the motion, that this subject be carried over to next year and a new committee appointed. As many as are in favor of this motion please manifest by saying Aye. The motion prevails.

President.—The next subject is number six, "Best design and recent practice in building railroad pile-drivers." This subject was reported on last year, and it was also discussed to some extent, but we should be pleased to hear something further on the same line.

Mr. Lichty.—This subject was pretty thoroughly covered last year, and we have had a great many very able comments on the report, also on the discussion of same that was participated in at last year's meeting, and I think that unless the members have something new to offer at this time that we should proceed to the next subject, unless some one has new views to offer.

President.—What is your pleasure, gentlemen? If no objections we will pass to the next subject.

President.—We will now take up subject number seven of last year, "Best material and designs for roundhouse pits, including drainage and rail fastenings." Mr. Arthur Montzheimer was the chairman, and report was prepared by him last year and discussed to some extent. What is your pleasure on this subject? (See discussion.)

President.—Anything further on this subject? If not, we will pass it.

Mr. Lichty.—Unless some other important business is on hand, I move that we adjourn.

President.—If nothing further on this subject, perhaps it would be wise to adjourn, as it is rather late to take up a new one, but before we do so, however, as Mr. Canty is now here, I would like to inquire if he has the report of the Auditing Committee ready.

Mr. Canty.—Yes, sir.

President.—We will listen to the report of the Auditing Committee.

Report of the Auditing Committee was thereupon read by Mr. Canty:

QUEBEC, CAN., October 20, 1903.

To the Association of Railway Superintendents of Bridges and Buildings:

The undersigned Committee on Auditing have examined the books and vouchers of Mr. S. F. Patterson, secretary, and with the exception of a clerical error of 11 cents found the same correct, as per the following recapitulation of receipts and disbursements:

RECEIPTS.

Dues and cash on hand in 1902	$755.48	
Sale of books	39.75	
Advertisements	900.00	
Total		$1,695.23

DISBURSEMENTS.

Expenses	1,504.20
Balance, cash on hand	$191.03

J. P. CANTY, *Chairman*,
H. RETTINGHOUSE,
H. H. EGGLESTON.

President.—You have heard the report of the Auditing Committee. What do you wish to do with it?

Mr. A. S. Markley.—I move that the report be adopted and the committee discharged.

President.—All in favor of that motion please manifest by saying Aye. Contrary minded, Nay. Motion prevails, and the report is adopted unanimously.

Mr. Steffen.—I would make a motion to adjourn until 10 o'clock to-morrow morning.

Mr. A. S. Markley.—I move that we make it 9 o'clock, as

there is a good deal of sightseeing to be done to-morrow and I think we had better start in early.

Mr. Steffen.—All right, I withdraw my motion to adjourn until 10 o'clock and second the amendment that we adjourn to meet to-morrow morning at 9 o'clock.

President.—As many as in favor of this motion in the amended form that we adjourn this meeting until 9 o'clock to-morrow morning, please manifest by saying Aye. Contrary, Nay. The motion prevails, and we stand adjourned until 9 o'clock to-morrow morning.

MORNING SESSION, WEDNESDAY, OCTOBER 21, 1903.

President.—Come to order, gentlemen, please, and we will proceed to take up the next question, which was the eighth subject of last year's reports, "Best materials for wearing surface of roadway of highway bridge floors." The subject was reported on last year, the chairman of which was Mr. W. O. Eggleston. It was not discussed to any great extent, and we are expecting that you will want to say a good deal about that this morning. (See discussion.)

President.—We will now take up the discussion of subjects of this year's reports. The first is, "Best falsework for rocky bottom in rapid currents where piles cannot be driven." We have a very fine report on this presented by Mr. Canty, the chairman of the committee, and we are waiting to hear what you have got to say about it. (See discussion.)

President.—We will pass to subject number two, "Should ties of bridges be gained so as to leave rail without camber, or should only a portion of camber be taken out." Mr. R. H. Reid of the Lake Shore is chairman. (See discussion.)

President.—We will pass to the next subject now, subject number three, "In case one arm of an important metal draw-bridge over a deep stream should be wrecked, what is the most expeditious way to restore railway and water traffic?"

President.—I will say that the chairman, Mr. Isaacs, sent a report on this subject, but it came too late to be printed in regular form, and was not circulated among the members before this convention.

Mr. Canty.—I do not see how we can discuss it very intelligently, and perhaps it would be well to carry it over until next year.

Mr. Steffen.—I move this subject be carried over to next year's convention. It is one that can be looked into quite fully, and there are quite a good many new members here who would probably like to have a chance to discuss it later.

President.—Shall we have a discussion on this report?

Mr. Montzheimer.—Was that report read? if not, and it is not too long, I think it should be read; at least, read the outline of it.

President.—I will ask our assistant secretary to read it.

Report on subject number three thereupon read by the assistant secretary. (See report.)

President.—What action will you take on this report, gentlemen?

Mr. Reid.—I think that it is a pretty deep subject, and it might be well to carry it over to another meeting, but there are one or two points in connection with some of the suggestions here; one of counterweighting the draw on the wrecked side. You take a 270-foot draw span, with one arm entirely gone, and try to put enough counterweight in the first two panels from the center and it seems to me it would tear everything all to pieces, and the other method of the pontoon would be too slow with ordinary heavy traffic, and I do not think it would be practicable, but if there is any one that has had experience along that line, I think it would be valuable to get their experience embodied in a further report, because this is a very important question.

Mr. Witt.—Before this question is passed, I would like to suggest that the subject also include plate girder draws, in case they should become disabled.

President.—Inasmuch as we have only just received this report and not had time to carefully study any of it, I think it would be well to pass this subject until next year; that is, the discussion of it, unless some of the members have had experience, as Mr. Reid suggests. If so, we would like to hear from them.

Mr. Reid.—I think it would be well to continue the committee on this subject for another year, in order to secure further information if possible, to enable them to make a still more valuable report by that time.

President.—Mr. Reid has suggested that the committee be continued until next year, with a request to secure additional information on the subject if possible. I do not know but that is asking considerable of the committee. Mr. Isaacs was very kind to begin with. I requested a good many members to take the chairmanship of this committee last year, and they all refused, until finally I applied to Mr. Isaacs, and he very kindly consented to do what he could in the matter.

Mr. Snow.—It seems to me this committee did about all they could on this subject. It is unusual to continue these committees after they have made a report, as Mr. Isaacs has done, and it seems to me that it is hardly necessary to depart from the usual custom. It comes up next year for discussion, any way, so I hardly think it necessary to depart from the regular rule, as I believe the committee evidently have done all they can in regard to the matter.

Secretary Patterson.—I will say to any members that are interested in this subject, if they will send written discussions to me, I will insert them in the Proceedings, and be glad to do so.

President.—That ground could be covered very nicely and perhaps better in a different manner. The majority of our members will not know anything of this report until the Proceedings are issued, then it will be too late; that is, too late for these Proceedings, and so we will take it as the sense of this meeting to request all members to give attention to this subject, and if they have had any experience and are unable to attend the next convention, to send written discussions to our next meeting. That might be easily covered by a motion to that effect, and then the whole matter will appear in our Proceedings. It is a very important subject, and that will bring it more particularly to the attention of our members, perhaps.

Mr. Montzheimer.—I will make a motion to that effect.

President.—It has been moved and seconded that we insert in our Proceedings a request on this particular subject that all our members shall give us the best of their experience in written discussions if unable to attend the next convention. If this be your mind, please manifest by saying Aye; contrary minded, Nay. The motion prevails. We will now pass this subject until the next convention, and take up subject number four, "What is the best form of traveler to use in erecting steel railway bridges of spans up to two hundred feet." We have received no report on this subject. What will you do about it?

Mr. McIntyre.—I move that it be continued to next year.

Mr. Reid.—Is there any letter or any communication from any member of the committee on this subject? Did they say they were unable to make a report for lack of information? If the committee are working on it and endeavoring to get out a report, it might be well to give them more time, but if they cannot do anything on it, it might be advisable to appoint another committee.

President.—I have received no communication myself.

Mr. Snow.—I move that this subject be referred to the committee on new subjects for consideration, to do with as they see fit.

Motion seconded and carried.

President.—We will pass to the next subject, number five, "Best method of protecting solid steel floors of bridges." This was reported on by Mr. A. O. Cunningham of the Wabash Railroad, and the reports have been circulated and are familiar to all the old members, and we are now prepared to discuss this subject. We await your pleasure.

Mr. Stannard.—On account of going out this afternoon I move that we now adjourn until to-night.

Mr. Markley.—I would like to meet the Committee on Nominations on the adjournment of this session.

President.—It is a question for you to decide, whether we shall continue this discussion now or whether to take this up this evening and have an evening session again to-morrow evening.

Mr. Montzheimer.—I move that we adjourn at 12 : 30.

President.—You have heard the motion that we adjourn this discussion at 12 : 30, until this evening's session. As many as favor this please say Aye, opposed, Nay. The motion prevails, and we will adjourn at 12 : 30. (See discussion.)

Mr. A. S. Markley.—For the boat excursion up the St. Lawrence river, that has been arranged for by Mr. Killam, I move that we call on the secretary for the amount to pay for this transportation, which I understand is $15.

Motion seconded and carried.

President.—If nothing further, gentlemen, we will now adjourn to meet again this evening.

EVENING SESSION, WEDNESDAY, OCTOBER 21, 1903.

President.—Come to order, gentlemen, please.

Mr. A. S. Markley.—We all know that our friend and brother, Mr. Killam, has been to more or less expense in providing this entertainment for us, printing, postage, telegraphing, etc., and I am quite sure that we all feel that he should not personally bear this expense, and I move that we request him to pass his bill to the secretary and that an order be drawn on the treasury for the necessary amount to reimburse him for all the money he has paid out in this direction.

President.—You have heard the motion; as many as are in favor of same please manifest by saying Aye. The motion prevails. It is a unanimous vote and will be so ordered.

President.—I will now declare a recess to allow the members to come forward and shake hands with Mr. Doucet, chief engineer, Quebec & Lake St. John R. R.

Recess was then taken for meeting the new member, Mr. Doucet.

President.—Gentlemen, will have to call you to order again. We like these pleasant meetings, and we certainly enjoy very much making a member of Mr. Doucet, and I am also very much pleased to say that we have with us to-night the general manager of the Quebec & Lake St. John line, Mr. J. G.

Scott. I am very much pleased to introduce him to you. Mr. Scott will you favor us with some remarks?

Mr. Scott.—Mr. Chairman and Gentlemen: I am no speech-maker but I am one of the local railroad men in this town, and I take this opportunity of bidding you all a very hearty welcome here, and hope it will not be your last visit to this city. There is very much in Quebec, ancient and historical and interesting, I think, even for a railroad man. We have a great bridge in course of construction up here over the River St. Lawrence which is to have the largest cantilever span in the world. I think I am not mistaken in saying that it is to be in the neighborhood of 1,800 feet. You are going to see that I believe, and I think you will find it very interesting. It is a matter of bridge construction which has been surrounded by many difficulties, very deep water, and a heavy current, and it is going to be quite a problem to erect that cantilever span, but you all understand that better than I can explain it to you, therefore to the next thing. Apart from that you are to have a trip to St. Anne de Beaupre, the celebrated shrine. Last year there were over 180,000 pilgrims visited that shrine, and you will find it very interesting. The line going out there runs through a very beautiful country along side the River St. Lawrence, and on this trip you will also take in the famous Montmorency falls, which are very beautiful. There is a hotel there, which was formerly the residence of Queen Victoria's father, the Duke of Kent, when he was commander of the garrison here over one hundred years ago. His winter residence was in a house only a block from here. There is certainly something historical in that.

If you have time we extend to you an invitation to take a trip on the Quebec & Lake St. John line as far as your time will permit, after your return from Montmorency falls, and we will have a special train ready for you at any time you wish to run out as far as you like and show you what kind of bridges Mr. Doucet makes us risk our lives in running over. I hope, gentlemen, that I have not detained you too long in talking this way, but I assure you that you will all be very welcome if you will come with us on Friday afternoon. I

thank you, Mr. Chairman and gentlemen, for the attention given. (Applause.)

President.—I am sure we all enjoy very much having Mr. Scott with us, and assure him that we appreciate the invitation that he has extended. I received a communication from him, but owing to not having a session this afternoon, I was not able to announce it up to this time, so had not made any arrangements to accept this courtesy, but I think we can safely announce at this time that Friday afternoon we will accept the invitation of Mr. Scott and take a trip over his line, leaving promptly at 1 o'clock Friday afternoon, and want as many members, in fact all the members, to go if they can, as Mr. Scott has very kindly offered us a special train for this purpose. I am sure that we know better than not to accept such kindness, and I wish to say that we are pleased to have him with us this evening, and would like to have him with us at all of our sessions from now on until the close of our convention, if possible for him to be with us.

President.—I have also received a communication which should have reached me before, but was forwarded from my home, from Mr. Robert Kerr, the general traffic manager of the Canadian Pacific Railway, regretting very much his inability to be with us, as I had extended an invitation to him to meet with us at this convention. He speaks highly of this Association, and states that he is very glad so many men on his line are coming in.

President.—I think we will now take up matters under discussion and continue where we left off at our noon-hour adjournment to-day. Subject number five, protecting bridges, was discussed quite freely, but if any one has anything further we would like to have them present it. Is there any gentleman who would like to be heard?

Mr. Stannard.—If in order, I would like to make a motion. I have been informed that our old friend and member, John Forman, has been retired from railroad service and I would move that this Association make him a life member.

Mr. Lichty.—We will all second that motion. Not any necessity for opposition votes on that from anybody that knows

John Forman. I think a standing vote would bring every member to his feet.

President.—I am going to put the motion just the same. All in favor of making John Forman a life member of this Association, please manifest it by rising. It is a unanimous vote and our old friend, John Forman, becomes a life member, and right at this time it might be as well to say that we received notice last year of an amendment to cover this life membership to be added to our constitution. I think Mr. Montzheimer has such a section prepared.

Mr. Montzheimer.—I move that the following section be added to article three of our constitution: "Section 3. Any member elected a Life Member of this Association shall have all of the privileges of an active member, but shall not be required to pay annual dues." Article III is entitled "Membership." This amendment was discussed at our last convention.

Mr. Lichty.—I would like to second that motion.

President.—You have heard the proposed amendment to Article III. Notice of this change in our constitution was given at last year's convention, consequently it is in order, and we are entirely competent to act upon it at this time. All in favor of same, please manifest it by raising their hand. Contrary minded, the same. The vote is unanimous.

President.—We will now proceed to the routine business. Do you desire to discuss subject number five any further, "Best method of protecting solid steel floors of bridges?" (See discussion.)

President.—If nothing further on subject number five, we will take up the next subject, but before doing so, now that Mr. Scott has retired, I will read his communication. I thought perhaps it might be unwise to do so while he was here. I received this communication after the forenoon session had closed.

President then read a letter from General Manager Scott offering to furnish passes next summer to any members who wanted transportation on his line.

Mr. Reid.—I think it would be well for our secretary to

acknowledge this communication, and thank Mr. Scott kindly for the courtesy extended.

President.—Would it not be better or more appropriate to extend a vote of thanks to him when he is present and show our appreciation of his kindness in that way? Really it is more of a courtesy than perhaps you all appreciate, because some of you may not know that his road runs through some of the most beautiful summer scenery on this continent, and there is one of the finest summer hotels in the country at Lake St. John. It is a most beautiful ride and very nice trip to take in the summer season, and perhaps it would be well to defer this matter of extending a vote of thanks to him until he is present in the convention hall. If you all concur in this we will leave it until to-morrow forenoon when Mr. Scott has promised to again be present with us.

Mr. Stannard.—The Committee on Resolutions must not forget Mr. Scott.

President.—No, sir, we will instruct them to that effect.

President.—I would like to add that our new member we just greeted to-night is one of the directors of the club up here. It is *the* club of the place, "The Garrison Club," and has extended a cordial invitation to any and all members to visit the club, and Mr. Lichty will try and arrange so we can visit there, perhaps in a body, some time before we leave Quebec.

President.—We will now pass to subject number six, "Best plans for small tool houses, including switchmen's and car repairer's shanties, and section, tool, and hand-car houses." The reports have been circulated among you, and we are ready for the discussion.

Mr. Snow.—I would like to ask if it is the intention of the Association to publish the blue prints or any part of them submitted with this report. Quite a batch of them were brought into the hall, and I wondered if they would all be published in the Proceedings.

President.—That is the pleasure of this convention to decide. It seems to me that it would be wise to publish them.

Mr. A. S. Markley.—I move that the plans that are presented with the reports by the various committees be published in our

Proceedings and that the secretary be authorized to have the necessary tracings made in order to have this done.

President.—It has been moved and seconded that tracings be made of the plans submitted by the various committees in connection with their reports and published in our Proceedings. If this is your pleasure, please manifest it by saying Aye.

Mr. Montzheimer.—Mr. President, before we act on this motion, I don't think that this order to the secretary should be unlimited. It seems to me that he should be allowed to discriminate a little in this matter, as in some cases the blue prints will not stand a reduction in size and in other cases there are repetitions, or practically so.

Mr. Lichty.—In regard to these illustrations I would make an amendment, to this effect, that this matter be referred to our member, Mr. Walter G. Berg, who can readily discriminate and pick out exactly which plans to use and no doubt get just exactly what we want, and I would offer that as an amendment.

Mr. A. S. Markley.—Our secretary watches that, he has been doing that for the last four or five years.

Mr. Snow.—The same thought occurred to me that Mr. Montzheimer has brought out, and I have no doubt Mr. Markley's idea was to leave it largely to the discretion of the secretary. I am in favor of his motion with that understanding. Don't know that it needs to be amended.

Mr. A. S. Markley.—I will amend my motion as suggested, to leave it to the discretion of the secretary as to what should be used, and let him decide which ones shall be printed in the Proceedings.

Secretary.—I would say that I always accept the assistance and help of Mr. Berg, and would more than likely consult him anyway, whether I am instructed to do so or not.

Mr. Sheldon.—I was unable to get in communication with the members of the committee of which I was chairman, and I thought I would submit all the plans and then the convention could do with them as they saw fit, but it certainly would not be advisable to print all of them, but just print part of them.

President.—I would state that perhaps we were a little bit quick in taking up that matter, but if it is agreeable to Mr. Markley and he will put his motion in that amended form, I think it will cover the matter.

Mr. A. S. Markley.—All right, I accept the amendment.

President.—Then we will act on the motion in the amended form, and all in favor of same will please say Aye. Contrary, Nay. The motion prevails.

President.—Subject number six is now ready for discussion. Does any member wish to be heard on this? If not, we shall pass this subject without discussion.

President.—I have a matter here that I would like to bring to the attention of the members, in regard to our trip to Halifax. On the way returning we are to visit St. John, and Mr. Killam has been making arrangements for a passenger steamer to take us up the St. John river on that trip at a cost of $40. What action do you want to take on this, gentlemen?

Mr. A. S. Markley.—I move that we take the trip and draw the money out of the treasury.

Mr. Lichty.—I second Mr. Markley's motion.

President.—You have heard the motion that we take that trip and that we draw from the treasury to pay the expense of that trip the sum of $40. All in favor of the motion please say Aye. It is a unanimous vote.

President.—We will now take up for a short time the discussion of subject number seven: "Best practical sanitary arrangements for small stations where there are no water or sewer systems." This subject was reported on by Mr. J. H. Markley. It is a very important one, and we would like to hear a discussion on it. (See discussion.)

Mr. Reid.—I notice in reading the report of the committee on this subject number seven that the committee stated they had sent out sixty circulars and received replies from only four persons. Now it seems to me that when we have a committee working on a subject and doing all they can, that each one of the members should also do what they can to help that committee along. It is certainly not very encouraging to send out a number of circulars and receive replies from only such a

limited number as the committee did in this case, and I think we ought to keep that in mind about answering circulars.

President.—Most of us who have been chairman of a committee have had just about that same experience.

Secretary.—I would like to say one word on this, that we would like to have the answers before the middle of September so we can have the advance committee reports printed for distribution prior to the convention.

President.—I think it would also be a good idea if the chairman of the committees could get these circulars out just as early as possible, as sometimes the members are very busy and have to take a little time on them in order to secure the data that the inquiry calls for.

President.—A motion will now be entertained to adjourn until 9 o'clock to-morrow morning.

Motion moved, seconded, and carried.

MORNING SESSION, THURSDAY, OCTOBER 22, 1903.

President.—We will come to order now, gentlemen.

Mr. Reid.—Before starting in, Mr. President, would like to say that last year at the meeting at Minneapolis there was talk among the members of a little track dolly for trucking timber on a rail and I spoke of one used on the Lake Shore, and several of the members asked me if I could give them an idea of what it was or a blue print of it. I had one of them photographed during the last year, and will leave the photograph on the table here so the members can see it. It is very convenient for handling timber on a rail.

Mr. J. H. Markley.—For the benefit of the members not here, I will make a motion, if necessary, that we put it in our Proceedings.

President.—I do not believe it will be necessary for a motion. We will just turn that photograph over to the secretary and he will fix that all right.

Mr. H. H. Egleston.—We use the same track dolly that Mr. Reid of the Lake Shore uses, and it is a good thing. Light and serviceable for handling any kind of timber on a bridge.

Track Dolly, L. S. & M. S. R. R.

Track Dolly, Boston & Maine R. R.

President.—They certainly look all right. What is the approximate weight of this, Mr. Reid?

Mr. Reid.—I should judge that the weight is probably 25 to 40 pounds complete.

President.—We will now take up the subjects under discussion. We did not finish subject number seven, "Best practical sanitary arrangements for small stations, etc." I think there are some gentlemen who desire to be heard on this, and we are awaiting your pleasure. (See discussion.)

Mr. J. H. Markley.—Glad to see so many good points brought out on this question, and it surprises me that I did not get more answers to my circular, but of course it is all right as it is going in our Proceedings anyway. I want to suggest a continuation of the question, but on a somewhat different line, and that is, for the coming president to name a committee of one to get up a paper, the subject to be on the line relating to cleanliness in and around our station buildings, to be read at our next annual meeting.

President.—Do you make that in the form of a motion?

Mr. J. H. Markley.—Yes, sir, I would make a motion to that effect; the name of the subject to be "Cleanliness in and around station buildings," to be read at our next meeting.

Mr. Killam.—I will second that motion.

President.—It has been moved and seconded that the incoming president be requested to appoint some gentleman to write a paper to be read at the next convention on the subject, "Cleanliness in and around station buildings." I think the idea is a very good one. As many as are in favor of this motion, please manifest by saying Aye; contrary, Nay. It is a vote.

President.—Do you care to say anything further on the subject under discussion, if not, we will pass to the next subject, number eight, "Best method of making annual inspection of bridges and culverts, and form of report to be made." Mr. Walter G. Berg has submitted a very complete report, and I am sure we are all much interested in it. We are ready for discussion. (See discussion.)

President.—Anybody else wish to say anything more on

this subject. If not, I think we can safely pass this subject as it comes up again next year.

President.—There are two more subjects that have been reported on but we have another evening session this evening in which we will consider those matters and we will now take up some miscellaneous business that we would like to transact at this time. One of the questions is to decide on a meeting place for next year. The assistant secretary has some communications that we would like to hear read. Mr. Killam has a friend whom he would like to introduce to us before we take this matter up.

Mr. Killam.—Members of the Association, I take pleasure in introducing to you the chief engineer of the Intercolonial Railway, Mr. W. B. Mackenzie.

Mr. Mackenzie.—Gentlemen, Mr. Killam has taken me by surprise. I had no idea he was bringing me here to introduce me formally to such a meeting as this. However, I am very much pleased to meet you to-day, and trust that I may have an opportunity of seeing more of you, particularly as you are going to take a trip over our road. I am quite sure there will be a great deal in the way of bridge construction, etc., there that you will be interested in, but aside from that there will be something probably of the country itself that will interest you, as the journey is rather a pleasant one and I hope you will find it so. We have been doing a good deal of new work on our road, have expended several millions in the last few years, and you will have an opportunity to see some of this work in the course of your trip. I have been very much interested, Mr. Chairman, in your discussions. In regard to protecting timbers I would say that we have used a good deal of creosoted material on our road, but mostly in wharves, not in any of our bridges to any great extent, but we have a very good opinion of it if the creosoting is properly done. Our experience has been that a comparatively small amount of surface treatment has proven just as good as the use of a large amount of creosote. As a matter of information to you, I would state that on the Intercolonial Railway our specifications call for the use of sixteen pounds of creosote per cubic foot. I do not think of

anything in particular to mention just at this time, Mr. Chairman, except to say that I am very glad of the privilege of meeting the members of your organization, and I sincerely trust your trip to this part of Canada will be a very pleasant one.

President.—I am sure I voice the sentiment of the entire convention when I say that we are very glad to have Mr. Mackenzie with us and I was struck with this thought while he was speaking, that he talked very much like a man that ought to be a member of this Association; and while this is an association of superintendents of bridges and buildings, I would state for the information of Mr. Mackenzie that we have a good many chief engineers who are members of our Association. We are naturally very proud of them; some of them are the most active of the members that we have. I think the Association will bear me out in the statement that one of our most active and most valuable members is the chief engineer of the Lehigh Valley System, and if Mr. Mackenzie can think as favorably of our Association as we hope he will we should be glad to have his name on our roll of membership.

President.—We will now pass to our regular business and I will ask the assistant secretary to read several communications which he has here on the table.

The assistant secretary thereupon read a number of letters expressing regrets at not being able to attend the meeting at Quebec, from our members Walter G. Berg, W. O. Eggleston, Onward Bates, W. A. Rogers, H. M. Henson, A. Shane, C. W. Gooch, O. J. Travis, W. A. McGonagle, and J. S. Lemmond.

President.—I want to say that last evening I delayed a motion that was made to extend a vote of thanks to the general manager of the Quebec & Lake St. John Railway, expecting that he would be with us this morning, and I promised you a chance to act on that matter at this time, as my idea was that it would be better to extend a vote of thanks and show our appreciation during his presence, but unfortunately Mr. Scott has been unable to meet with us this morning, and I think it would be well for us to act on that matter at this time.

Mr. Montzheimer.—I move that a vote of thanks be passed

by this Association to Mr. Scott for his very kind offer, and thank him for his kindness.

Mr. Lichty.—Second that motion.

President.—You have heard the motion. As many as in favor of the adoption of it, please so manifest by rising vote. The motion is passed unanimously.

President.—Now we will take up the matter of our next meeting place for holding our convention next year. Perhaps you are all familiar with the mode of procedure, but I will state for the benefit of the new members that it is decided by a majority vote, after the several cities have been put in nomination, and we vote by ballot for the meeting place for next year. We will listen to nominations now.

The following cities were then nominated as places for holding the next annual convention of the Association, viz., Chicago, St. Louis, Milwaukee, and ballot taken.

President.—Gentlemen, come to order, please, now and give us your attention and I will give you the result of your ballot. Total number of votes cast, 54. Necessary for choice, 28. Milwaukee, 6; St. Louis, 10; Chicago, 38. Consequently you have decided on Chicago as the place for holding our next meeting by a very large majority vote.

Mr. Ingalls.—I think a year ago this Association established the precedent of making any superintendent of bridges and buildings, who had been a long time in the service and had retired from active life, a Life Member. We have such a member here; he belongs to the North Western and has had nearly fifty years of active service and is now in his eightieth year, and I would like to make a motion that Mr. W. D. Walden be made a Life Member of this Association.

President.—I understand he has retired from active service.

Mr. Stannard.—I second the motion.

President.—It has been moved and seconded that Mr. W. D. Walden be made a Life Member of this Association, entitled to all of its privileges, without dues or assessments. If this be your wish, please so manifest by rising vote.

President.—It is a unanimous vote, and Mr. Walden is elected a Life Member of this Association.

Mr. Montzheimer.—I think we should also vote on making Henry Crane a Life Member of this Association; he was born in the same month and the same year as Mr. Walden. I think he has been retired and is receiving a pension, and I am sure he ought to be accorded the same honor as Mr. Walden.

President.—I will take that as a motion from Mr. Montzheimer, and will be very glad to see Mr. Henry Crane, also of the North Western, and retired from active service, be made a Life Member of this Association. All in favor of this action being taken, please so manifest by rising vote. It is unanimous, and Mr. Henry Crane is hereby declared a Life Member of the Association with all privileges.

Mr. Walden being called for, responded as follows:

Mr. Walden.—Gentlemen, there is one thing I have never learned, that was to make a speech, but I assure you I feel the honor you have bestowed on me to-day, and feel very grateful to you. I have been in the service of the North Western Railroad company for something like nearly fifty years; commenced railroading in Iowa in 1855; started out from New York with Mr. Johnston, a civil engineer of the state of New York. I became acquainted with him when I was an architect in Brooklyn, N. Y., and received an order from him for plans for a hotel which was to be erected at Suspension Bridge, N. Y., after that building was completed; it was started in 1854 and completed sometime in the spring of 1855, and about the time it was completed he called on me for plans for a hotel to be erected at Clinton, Ia., and I made the plans and came out to Iowa and started the building and went back, but that summer the engineer was very anxious for me to come back and superintend that building and also build the bridges on a new railroad that was then contemplated in that vicinity. A great deal of grading was done for this new line, but no bridges were put in, and finally it fell through, but was afterwards reorganized and called the Chicago, Iowa & Nebraska Railroad. In the spring of 1856 Mr. Milo Smith came out; he was the engineer, and they made a new survey from Clinton towards the West, and ran it out about forty miles, and commenced building what is now a part of the North Western

Railroad. When we got to a point about forty miles west of Clinton they were undecided whether to go to Iowa City or Cedar Rapids; finally the Cedar Rapids people made the best bid for the railroad and it went there. After I finished that work there was nothing that I could find ready to do in my line of work, and I went South, down to the state of Louisiana, but just about that time they got up a little muss down there and I had to get out of that. I came back up North. Well, I got home again, gentlemen, and I had to stir around to find something to do, and the first thing I got after I had been home a few days, General Stewart said that they needed a young man that was pretty active, and I got an offer to go down and join his company, but I had been south before and had seen them handling so much ammunition down there I thought I did n't want any of it, and so I concluded to stay at home and wait until something turned up. After I had been home for some time I went to work on the North Western Railroad, in February, 1863, and I am still in their employ now, but not in active service. I was retired from active service in 1901. I received from our folks when I was leaving the service a letter that I am very proud of. (Letter read by Mr. Lichty.) I just want to say to you once more, gentlemen, that I thank you for the honor you have bestowed on me to-day.

Mr. Crane.—I also want to thank you, gentlemen, for the honor you have conferred on me by electing me a Life Member of this society. Mr. Walden is a better speechmaker than I am, so I will leave that part of it to the other fellow.

President.—I am happy to say that I have for your consideration an application from W. B. Mackenzie, the chief engineer of the Intercolonial Railway, for membership in our Association. Please take action on it at once.

Motion carried to elect Mr. Mackenzie and add name to original report of application committee.

President.—I wish to announce that we leave at two o'clock this afternoon for a trip up the river to the new bridge under construction, and it is very desirable that every one take this trip.

President.—Motion to adjourn will be in order.

Mr. Stannard.—I move that we now adjourn until 7 : 30 this evening.

President.—Please approve this action by saying Aye. The motion prevails, and I would like to request all of the members to be on hand promptly at 7 : 30 this evening, as we have some important business to transact.

EVENING SESSION—THURSDAY, OCTOBER 22, 1903.

President.—Will you please come to order, gentlemen; it is now after 7 : 30.

President.—We will take up the discussion of subjects, and the next subject in order is subject number nine: "Water filters or other methods of purifying water for engine use." Subject was reported on by Mr. R. C. Sattley of the North Western, chairman of the committee, in a very full and complete report, and if any one would like to discuss it we would be glad to hear from them.

President.—I would like to ask how many of the members here at the present time are interested in water purification and would like to have this subject discussed. It appears two members down here are anxious to have it discussed, but it seems hardly necessary to take up this subject, because the paper so thoroughly covers it that we can get all the information we want from that, but perhaps these two members would like to have it discussed.

Mr. Lichty.—I think the president has raised a pretty good point. The report is very complete, and probably it would be as well to look that over and let it go at that without discussion until next year.

President.—Most of the Eastern members can get an abundance of pure water without any filters.

Mr. Lichty.—What I want to say is this, I don't like to go into a discussion of a subject of this kind where so many are not interested in it. Of course if there is anything that we can say on the subject to help out these two members it is all right, but if not, these two members can get what information they are able to out of this report, and read up on it elsewhere.

Mr. Horning.—I believe I am one of those members. I am

not particular about having the matter discussed. I have some filters on our road meeting with good success and perfectly satisfactory. I think possibly it would be well enough to let the matter pass.

President.—Then we will waive the discussion of this subject and pass on, as this will come up next year, when perhaps there will be quite a good many more members who have had experience in the matter than we have this year. (No discussion on subject number nine.)

President.—The next is subject number ten, "Best method of storing fuel oil, with appliances for supplying locomotives, including plan of water stations, showing relative arrangements of fuel and water supply." This subject was reported on quite fully by Mr. C. C. Mallard, chairman of the committee. Do you wish to discuss it?

President.—Any member anything to say on this? We are waiting for you. If not, I think the question should receive the same treatment as "water filters," as but very few members are using oil as fuel and it would also perhaps be well to pass this without discussion this year.

Mr. Lichty.—It might be that a few of the members present are using something of this kind and could give us a brief outline of what they are doing, and if there are any advantages connected with it.

Mr. Canty.—Mr. President, I would state that in the Hoosac tunnel the gases from the locomotives are a source of great trouble to the men working in the tunnel and they have tried to run engines through there, using oil for fuel. A station was established near by and considerable money spent there for storing oil; the oil runs in from cars to tanks by gravity and is pumped by a steam pump, each locomotive pumping out its own oil. I understand from experiments tried lately the thing has not been a success and will be done away with, although this particular point has nothing to do with storing fuel oil. I would say that the fumes from the fuel oil are about as bad as the fumes from the coal.

President.—Mr. Powers, have you anything to say?

Mr. Powers.—Mr. Canty spoke for me.

President.—This subject is rather new to most of us and perhaps but a few are familiar with it and we may possibly be more familiar with it in another year. We might perhaps gather something from the report published in the Proceedings that will be helpful, but any additional information not included in the report would be well to give to us now, in order that it may be printed in the Proceedings, as it may help some one between now and another year.

President.—Any member anything to say on this matter? If not, we shall pass this subject. That closes our subjects for discussion inasmuch as subject number eleven was not reported upon, and recommended to Committee on Subjects to be continued.

President.—I shall have to refer now to subject number four, "What is the best form of traveler to use in erecting steel railway bridges of spans up to two hundred feet?" This subject is one of those not reported on and it was your pleasure to recommend it to the committee to continue the subject for another year, and I believe the committee have embodied it in their report. Since then, however, to-day, we have received a partial report on the subject. I don't know that you would hardly call it a partial report and I don't know that I ought to say what I am going to say, but here is a splendid reply, evidently to a circular of inquiry sent out by that committee from Mr. Edinger. That is all the committee have given us for a report, simply Mr. Edinger's reply, which takes the matter up very nicely and certainly is very good indeed, though I think that hardly excuses the committee. I, for one, am not disposed to consider that a full report, but I am waiting to hear what action you wish to take in the matter.

President.—Shall we continue the subject as we instructed the Committee on Subjects to do and turn Mr. Edinger's contribution over to the committee, or shall we accept it as a partial report and discuss the subject from this?

Mr. Horning.—I move that the subject be left as it now stands, which will bring it up next year.

Mr. Lichty.—I would like to see it treated in this way. I would like to see this reply printed and sent out to members

the same as the other subjects were, for the members to look over and see what is contained in that and then appoint a new committee to act on it and let the other members in replying to the new committee take advantage of the good work turned in by Mr. Edinger. It might give them some assistance in helping out the new committee to report, and have it reported in the Proceedings next year, but have copies printed and distributed among the members this year.

Mr. Canty.—I will second Mr. Lichty's motion.

President.—I understand it does not conflict with Mr. Horning's motion in any way; simply a supplementary suggestion that this portion be added.

President. You have heard the motion to the effect that this subject be continued as part of the committee's report on subjects and that the secretary be requested to issue to each of the members Mr. Edinger's contribution to the subject in pamphlet form the same as advance reports. If this be your mind, please manifest by saying Aye, contrary minded, Nay. It is a vote, and the secretary is so instructed.

President.—Next in order will be the report of Committee on Subjects. We will listen to the report of the committee on selection of subjects for next year and ask the assistant secretary to read the report.

Assistant secretary read the report.

SUBJECTS FOR REPORT AND DISCUSSION FOR 1904.

To the President, Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your committee appointed to select subjects for next year's meeting beg to make the following report:

I. What is the best form of traveler to use in erecting steel railway bridges of spans up to 200 feet.

II. What has been the experience in use of concrete under bridge bed-plates and turn-tables in place of pedestal stones, and what is the best form and material for bed-plates under various styles of iron bridges.

III. Best methods of caring for trestles while being filled.

IV. Best forms of construction for engine houses.

V. Best methods of filling ice houses and conveying ice to refrigerator cars.

VI. Best methods of filling track water tanks automatically.

VII. Steam hammers versus drop hammers for pile-drivers.

VIII. Best form of construction for docks and wharves.

IX. Best record forms for buildings, water tanks, etc.

X. Best freight and roundhouse doors,—and fittings for the same.
XI. Best methods for preserving timber and piles in structures.
XII. Best methods of protecting low overhead structures over tracks from gases and blast of locomotives.

C. W. VANDERGRIFT,
A. MONTZHEIMER,
D. C. ZOOK,
J. P. SNOW,
J. H. MARKLEY,
F. S. EDINGER,
H. RETTINGHOUSE,
H. A. HORNING,
Committee.

President.—You have heard the report of the committee, gentlemen, do you want to criticise it in any way?

Mr. Snow.—I move that the committee's report be accepted.

Mr. Sheldon.—I understood in this year's subjects there was one that was not reported on that was to be continued in the subjects for the coming year, and that was the protection of low overhead structures from gases and blasts from locomotives, but I did n't hear it read. No report on it this year. This is a subject I am considerably interested in; have quite a little of that class of structures and a good deal of trouble with the little we have, and would like to get the experience of the other members.

President.—I think it was decided that this action should be taken, but I see that they have not included it, and so we will revise their work if you like.

Mr. Stannard.—I move that it be added to the list.

President.—It has been moved and seconded that this question of protection of low overhead structures over tracks, etc., be added to the list of subjects as reported by the committee.

Mr. Lichty.—It seems twelve subjects are a good many for one year. I don't know that the icing of refrigerator cars comes under the superintendents of bridges, and perhaps it might be well to drop one of the other subjects, to be taken up at some other time. Perhaps twelve are not too many, but it makes considerable work to take care of eleven subjects in good shape.

President.—I think the point is well taken.

Mr. Pennewell.—In regard to icing refrigerator cars, I consider that a very important subject to me at the present time,

as we just completed an $18,000 ice house. Had all kinds of trouble with it, and I was just rejoicing that I was going to get that before the convention.

Mr. Ingalls.—I would like to hear that subject discussed.

Mr. Lichty.—I withdraw my suggestion, Mr. Chairman, in regard to this matter.

President.—As to the subject of best method of protecting low overhead structures from blasts from locomotives, it has been moved and seconded that we add this subject to the committee's report. If this be your wish, please manifest by saying Aye; contrary minded, Nay. It is a vote.

President.—Now I do not know, but would like to ask for information, just what the committee means here on subject number three, "Filling trestles where permanent structures have been put in." I think the question is a little bit dark. The wording of the question does not seem to read plain. If permanent structures, what's the use to fill them?

Mr. Snow.—I move that the wording of the subject, number three, be changed so that it shall read, "Best method of caring for trestles while being filled, where permanent structures have been put in."

Mr. Sheldon.—I will support Mr. Snow.

President.—That would seem to be nearer right, and if this be your minds, that this wording be changed to that effect, please manifest it by saying Aye; contrary, Nay. The motion prevails.

President.—Now, gentlemen, what will you do with the report as it stands? Are there any other criticisms or amendments? If not, as many as in favor of accepting the report as now amended by adding the other subject that we voted on and changing the wording of subject number three, please manifest it by saying Aye; contrary, Nay. The report is accepted.

President.—Has any member any business that he would like to present? I believe the Committee on Resolutions have not yet reported, and if they are ready, would like to hear their report.

Report of Committee on Resolutions read by Mr. Merrick.

REPORT OF COMMITTEE ON RESOLUTIONS.

Your committee begs leave to report as follows:

Resolved, That the thanks of this Association are hereby tendered

To the Pullman Car company, who through its management and representative, Mr. Ritchie, at Quebec, furnished the usual half rate on sleeping cars.

To the Grand Trunk Railway Company, through Mr. F. H. McGuigan, general manager, for special train in charge of Mr. Finley, from Montreal to Jubilee bridge and the works of the Dominion Bridge company.

To the Canadian Pacific Railway, through Mr. Robert Kerr, traffic manager, for special train from Montreal to Lachine bridge and their new shops at Hochalaga. The Association wishes especially to express its appreciation of the very nice luncheon served on this train, and the kind attention of Messrs. Goldmark and Metcalf.

To the Intercolonial Railway company, who, through Mr. D. Pottinger, general manager, Mr. J. E. Price, superintendent, and Messrs. Tiffen, Lyons, McKenzie, and Lambkin, provided a special train of sleeping and dining cars for the trip from Quebec to Halifax, Sydney and St. Johns, and return to Montreal. The careful arrangements and unusual provisions for the comfort of members rendered this trip a most delightful one.

To the Quebec & Lake St. Johns Railway company, through Mr. J. G. Scott, general manager, for special train taking members and guests over their line, and also for the generous offer of transportation for visiting members next summer.

To the Montmorency & St. Anne de Beaupre Railway company, through Superintendent Russell, who kindly arranged for an excursion to the famous falls and shrine from which the railway derives its name.

To Mr. Robert Kerr, general traffic manager Canadian Pacific Railway, Mr. Frank Barr, general manager Boston & Maine Railway, Mr. C. D. Hammond, general superintendent Delaware & Hudson Railway, and Mr. F. H. McGuigan, general manager Grand Trunk Railway company, for courtesies in furnishing transportation for members upon application of the president of this Association.

To the Sydney & Louisburg Railway company, for special train to the Marconi towers at Glace Bay.

To Mr. Richardson, mayor of Sydney, and members of the city council, for trip on steamer to North Sydney and visit to the Dominion Iron and Steel Works, where the party was met by Mr. Ross and conducted through the plant.

To Mr. Goldrick, acting mayor of St. Johns, and representatives from the city government, who kindly furnished the steamer *Lord Kitchener* for trip on the Bay of Fundy.

To Mr. A. E. Pyerfer, pro mayor of Quebec, for a hearty welcome to this beautiful city.

To the Quebec Garrison club, for a cordial invitation to visit their club house and the tender of the hospitality of the club to the members of this Association.

To the St. Louis Railway club, through Mr. Stannard, who have kindly invited any of the members to make free use of their quarters at St. Louis during the exposition.

To Mr. Reid, manager of the Chateau Frontenac, who has upheld the reputation for Canadian hospitality and forwarded the interests of the Association in many ways.

To the representatives of the Railway Supply companies and

others, for their exhibits of various devices and materials, and for numerous courtesies extended to members of this Association.

Your committee desires to emphasize the fact that, at this the largest meeting in its history, this Association has found at every point the most courteous hospitality and complete arrangements for its comfort and pleasure. It does appreciate this, and it especially acknowledges the efforts of Mr. A. E. Killam and Mr. W. E. Alexander.

Respectfully submitted,

A. W. MERRICK.
J. I. BANKS.
A. O. CUNNINGHAM.
A. MONTFORT.

Mr. Lichty.—I would call the attention of the committee to two things that I think should not be omitted. The special train furnished by the Grand Trunk at Montreal and the other to Lachine Bridge by the Canadian Pacific.

President.—I want to say another thing, that I did not inform the committee as fully as I should have done myself. The thanks have been extended to the Boston & Maine Railroad for transportation for members, but no mention made that the transportation was kindly furnished upon the request of the president of this Association to show that it was on account of a request from this Association that this transportation was secured from the Boston & Maine and a like courtesy was extended by the Grand Trunk and by Mr. Robert Kerr of the Canadian Pacific. You understand, gentlemen, that the members in the Trunk Line territory, their general officers, would not ask for transportation for them and they have secured transportation over these three lines upon the request of the president of this Association, by the kindness and courtesy of Mr. McGuigan of the Grand Trunk, Mr. Kerr of the Canadian Pacific, and Mr. Barr, general manager of the Boston & Maine. Now, if we mention in this resolution the special trains furnished by the Grand Trunk and the Canadian Pacific, I think we should also mention this transportation and the fact that it was furnished upon the request of an officer of this Association. I would like to go over that ground a little more explicitly. The proof that the roads have given us this courtesy is an early recognition of the great benefits the railroads have received from this Association in the raising of the B. and B. standard all over the country, and I would respectfully

suggest that we recognize this fact in the resolution, and extend to Messrs. McGuigan, Kerr, and Barr a special testamonial in our resolution. This transportation question is a serious one before this Association, especially to our members living in the Trunk Line territory, in regard to reaching conventions of this Association, and there must be some provision made. This is a matter that our executive committee has got to take up before our next meeting, as the most of us do not receive salaries large enough so that we are enabled to attend these conventions and pay our fare all the way, and I think it would be wise for the executive committee to appoint a special committee to go before the Trunk Line association and request that an exception be made in favor of this Association in recognition of the benefits the various roads receive from our meeting annually in this way. I would add that Mr. Kerr has been especially kind in regard to the matter of transportation. One of the members came to me this morning and desired transportation over the C. P. in order to reach his home more easily, and I telegraphed Mr. Kerr this morning after the morning session, and this afternoon received an answer back by wire that he had sent the transportation as requested, so you see it is a very great courtesy and we should appreciate these things.

Mr. Lichty.—I suggest that these resolutions be changed in accordance with the views expressed and be acted on by the chairman and let him settle that matter with the rest of the committee.

President.—Then you would practically approve the report to be amended under the direction of the chairman? Do you make that a motion?

Mr. Lichty.—Yes, sir.

Mr. Steffen.—I second the motion.

President.—If this be your mind, please manifest it by saying Aye.

Mr. Swett.—I think you omitted to mention the Fur Company's invitation to visit their factory.

President.—That will be added in the same way by the motion.

President—As many as are in favor of the motion please say Aye, contrary, Nay. Motion carried.

President.—If nothing further, or any further announcements to be made, I will read the report of the nominating committee, but before doing so I will state for your information, because we all want to say good-by to our chairman of this committee, before he goes away, that Mr. A. S. Markley has received a telegram from his son-in-law this evening that his daughter is seriously ill and for him to come at once. We are indeed very sorry to learn of this and it will be a great disappointment to him, of course, as he had intended to go with us on the trip to Sydney.

Report of the nominating committee was then read by the president.

QUEBEC, Ont., Oct. 22, 1903.

The Committee on Nomination of Officers for ensuing year beg to make the following report:

President.—Arthur Montzheimer.
First Vice-President.—A. Shane.
Second Vice-President.—C. A. Lichty.
Third Vice-President.—J. B. Sheldon.
Fourth Vice-President.—J. H. Markley.
Secretary.—S. F. Patterson.
Treasurer.—C. P. Austin.
Executive Members.—R. H. Reid, W. O. Eggleston, A. E. Killam, R. C. Sattley, H. Rettinghouse, J. S. Lemond.

A. MARKLEY,
JAMES STANNARD,
W. E. ALEXANDER,
F. S. EDINGER,
A. E. KILLAM.

President.—The title chairman is wrong, the chairman of the executive committee is the president of this Association always, and I will change it.

Mr. Stannard.—I would like our president to read the constitution before he makes that change. I was president when that constitution was gotten out and it was not intended to have the president the chairman of the executive committee. He was to act with the committee or in conjunction with the executive committee.

President.—I think it will be necessary to make an amendment to the constitution, if that is the intention of the Association, and if you desire to make any change in the constitu-

tion, a notice to that effect will be in order now; if not, we will take up the report of the nominating committee, and I will ask what you wish to do with it. The accepting of the report does not elect the gentleman. What do you wish to do with the report?

Mr. Large.—I move that the report be received.

Mr. Snow.—Second the motion.

President.—One remark for the benefit of the new members. That is, I understand the accepting of the report of this committee does not prevent any member nominating whoever he may see fit from the floor of this convention. As many as are in favor of accepting this report will manifest it by saying Aye. It is a vote.

President.—Now, gentlemen, if there are no other nominations, we will proceed to ballot on these names.

Mr. Ingalls.—I move that the secretary cast the ballot for the various officers.

Mr. A. S. Markley.—The secretary might take exceptions to that. No man wants to vote for himself. I would suggest Mr. Stannard. This can be done by unanimous consent.

President.—The motion before the house is, that Mr. Stannard be authorized to cast one ballot for the names as they appear upon this report. If this be your minds that Mr. Stannard perform this duty, please manifest it by a rising vote.

President.—It is the unanimous consent of this body that Mr. Stannard cast the ballot.

Mr. Stannard.—Mr. Secretary, this is my ballot.

Secretary.—The ballot is cast, Mr. President.

President.—The ballot has been cast for the names on this report, and you have therefore elected the following gentlemen officers for the ensuing year:

President.—Arthur Montzheimer.
First Vice-President.—A. Shane.
Second Vice-President.—C. A. Lichty.
Third Vice-President.—J. B. Sheldon.
Fourth Vice-President.—J. H. Markley.
Secretary.—S. F. Patterson.
Treasurer.—C. P. Austin.
Executive Members.—R. H. Reid, Cleveland, O.; W. O. Eggleston, Jersey City, N. J.; A. E. Killam, Moncton, N. B.; R. C. Sattley, Chicago, Ill.; H. Rettinghouse, Kaukauna, Wis.; J. S. Lemond, Atlanta, Ga.

President.—Before relinquishing the duties of this office I desire to say that you all have my most heartfelt thanks for the great honor conferred upon me in electing me to this office and for the hearty support and coöperation that you have given me during the year just past, and for evidence of which we have just held the most successful convention, perhaps, in our history. I do not wish you to think that I desire to take any of the honor or any praise for this grand result for myself, but it is because of the hearty coöperation of the various committees and the individual membership of this Association that this result has been accomplished or brought about. I especially desire to call your attention to the splendid reports we have received and the fact that we have missed so few reports. We had a list of ten subjects to be reported on, and we received some sort or form of report for all but one of these subjects and the chairman of this committee expected to make a report on that, and wrote me a month ago, perhaps, that he certainly expected and hoped to be able to make a report; but at the last moment, just a short time before coming to the convention, I received a communication that unexpected duties had interfered with his making this report and he very much regretted his inability to do so. I think this is a splendid record and speaks very highly for the committees and for the chairmen of these committees and for the individual membership as well, and in view of this, I would ask that you give to my successor and to the gentleman succeeding to the management of this Association for next year an even more cordial support than what you have given me and my associates this year. Mr. Montzheimer, you have been elected to the office of president of this Association. Do you accept the office?

Mr. Montzheimer.—I do.

President.—I will turn over to you now the management of this Association, and may you have the greatest of success

Mr. Montzheimer.—Members of the Association and Friends: I do not know how I can express to you my appreciation of the honor that you have conferred upon me. I am not an orator and do not think you can expect me to make a speech.

I can only say a few simple words expressing a few things right close to my heart. We are all interested in the advancement or progress of our Association. I know it has been a great pleasure in the past to see it grow so steadily and gain in importance each year. I wish I could impress on you the importance of individual work. Try as hard as they can, the officers of the Association cannot produce success, or at least that perfect success, without the help of every member of the Association, be it little or great. I know you have given this aid in the past, and sincerely hope we can expect it from you in the future. I am glad to say that this convention has broken the record as regards the admission of new members for the last eleven years, and it must do our friend John good to have the meeting at Quebec, at this ancient and historical place, break the record. (Applause.) At Atlanta, thirty-eight new members came in; at Cincinnati, in 1892, about fifty-two were admitted, but this was only the second year of this organization's life, and of course a large number came in in the first and second years, but I think we have certainly made a remarkable showing this year. I noticed that in the last eleven years, previous to 1902, the Association had a growth of 300 per cent., just about an average of 10 per cent. per year compounded each year. Our bridge and building men of the various railroads in America are beginning to see the necessity of belonging to an association of this kind, and find, after hearing our discussions and reading the committee reports, that they can not only do better work, but do it more economically; and not only the bridge and building men are finding this the case, but the maintenance of way people also look for our reports and convention proceedings. I know from personal information that several prominent maintenance of way men of this country regularly look for our Proceedings, and read them through. For my part, I will do all I can to carry forward our work, and I hope if any of the members have any suggestions to make, that they will give the officers of this Association the benefit of their suggestions. You can all help if you only will. One thing makes this Association unique, and that is the brotherly, friendly feeling that you all

see in the convention. There is no wrangling; no selfishness comes to the surface. Every one is pleasant and good natured, and I think it bears out the old saying, "Who best can work can best agree." I hope we will all push together, and go farther to the front, as I know we will. Gentlemen, I thank you. (Applause.)

President.—The next member present on the list is C. A. Lichty, second vice-president. Mr. Lichty, do you accept?

Mr. Lichty.—Gentlemen, I thank you for the honor bestowed upon me in electing me second vice-president, and I will do all I can for the advancement of the Association. I thank you.

President.—Mr. Sheldon, you have been elected third vice-president of this Association. Do you accept?

Mr. Sheldon.—I thank you for the honor, and will endeavor to fill the position to the best of my ability.

President.—Mr. J. H. Markley, you have been elected fourth vice-president. Do you accept.

Voice.—He is not in the room, yet I think we can safely assume that he will accept.

President.—Mr. Patterson, you have been elected secretary. Do you accept?

Secretary Patterson.—I do, and thank you for the honor.

Secretary Patterson.—Mr. President and Gentlemen: I will say I appreciate this honor conferred on me, and I really consider it a very great honor, inasmuch as I have already served twelve years as secretary of this Association. It is a great source of pleasure to me to see it grow, not only in numbers, but in importance. I feel proud to be associated with this class of men, and I have found that it has been good for me to know you. I find that I gain something of value every time I meet you, and the happy, cordial reception given me certainly gives me great pleasure. I little thought twelve years ago when I went to Cincinnati, a perfect stranger to every one,—I don't think that I knew a single person,—and when I was very unexpectedly elected secretary and I was so extremely timid that I did not or could not refuse, and so have continued on from year to year. As I said before, I feel

proud of having served you so many years, and I may say also that as yet I have never heard one single objection to my filling this office, and this, too, is a great satisfaction to me. You have been very liberal and kind to me in every way, and I hold the friendships that I have formed since belonging to this Association very near and dear, some of them the best and dearest I have. I am also very much flattered with the words of cheer that I received from my friends, the supply men, who come here to meet with us each year, and also occasionally the words of praise that I hear for the appearance of the book of our Proceedings, and I cannot help feeling rather proud to hear that the book has a good appearance, and it gives me very much encouragement and I promise to do the best I can. I would like to say one word in regard to receiving the committee reports. If you do not want the Deacon to go crazy, don't wait so long. I begin to receive requests for advance copies weeks before I even see the reports, and it requires great exertion to get them out so as to send the advance copies out to the members. Again I thank you, gentlemen, for the honor that you have conferred upon me. (Applause.)

Mr. Pickering.—I would like to say, and I think I voice the sentiment of this Association when I say it, that I am heartily glad that our good friend, Mr. Patterson, has never gotten up the courage to decline the office of secretaryship of the Association, and I want to say still more than that, that at the dinner table this evening, in conversation with one of the charter members of this Association, the subject came up of the success of this Association, and the few changes necessary to be made in the management and in the constitution and by-laws, and all that sort of thing, and I made the remark that it seemed to me that the old saying was wonderfully true that the organizers of this Association had builded better than they knew when they organized this Association. I think that will apply wonderfully well, too, in regard to the election of our worthy member as secretary of this Association. I think they builded better than they knew when they elected him first for secretary; for, gentlemen, do you understand,—I know you

do not, you cannot comprehend how much the success and advancement of this Association depends upon the careful, painstaking work of its secretary. This has been the experience of all technical societies, that the office of secretary has been the most important one in the relation of the success and advancement of the society, and certainly there is no exception at all in this society, and the success has been in a large measure due to the careful and painstaking work of our secretary, Mr. S. F. Patterson, and I am sure we are all heartily glad that he is able to continue such a good work. (Cheers.)

President.—Mr. Austin, you have been elected treasurer of this Association. Are you willing to serve?

Mr. Austin.—I am, and thank you for the honor.

President.—Mr. Reid, you have been elected an executive member. Are you willing to serve?

Mr. Reid.—I understand that there is nothing for that committee to do, so I accept.

President.—Mr. Killam, you have been elected an executive member. Will you accept?

Mr. Killam.—I will.

President.—Mr. Rettinghouse, you have also been elected an executive member. Are you willing to serve on that committee?

Mr. Rettinghouse.—I sincerely thank you for the honor that has been conferred upon me, and will assist the committee all I can.

President.—The other three members, Messrs. Eggleston, Sattley, and Lemond are not present, but I think that it is safe to say they will serve for the term.

President.—Any other business to come before the Association at this time?

Mr. Steffen.—I think that it is time, on behalf, possibly, of the new members, of which I am one, that some vote of thanks in recognition of the personal efforts of Mr. Killam would be very much in order, and I move that a rising vote of thanks be extended to Mr. Killam for the noble and unceasing efforts put forth in our behalf at this time to make our stay in this city a success.

Mr. Pickering.—I can heartily second that motion because I know that very much of the pleasure that we have derived from this meeting, and much of the success of this meeting has been due to the unselfish and unflagging efforts of our worthy Committee of Arrangements, and I heartily second that motion.

President.—Gentlemen, you have heard the motion. I think we should take a rising vote, to express a little stronger our feelings in the matter.

President.—The vote is unanimous. Mr. Killam, we would be glad to hear a few remarks from you.

Mr. Killam.—Mr. President and Friends: I am sure I did not expect anything of this kind, but I want to say that it gives me great pleasure to answer my name in reply to your magnanimous vote of thanks, and to say that what I did I simply did for what I thought was for the benefit of the Association and for the advantages that will accrue to our own part of the country. I was most happy to hear the remarks made by one of the members at this meeting in reference to the two great nations, the greatest of the earth, that they should be one, and I am sure it would give us the greatest of pleasure to take you in. This Association is one of the institutions that works for the benefit of the whole country and for the safety of the traveling public, meeting here together in this way to discuss matters pertaining to our calling, that we might be better able to fill the office to which we are appointed and to work for the good of the whole people. Therefore, it is with the greatest of pleasure that I accept this motion, and when we get through—we are not, though, yet,—I don't know but what you will want to pass another vote of thanks to our country that we have down here in the East. I thank you, Mr. Chairman. (Applause.)

Mr. Stannard.—We are all very thankful for the invitation of Mr. Killam to take us in, and whenever we get to that point we will apply; but he has certainly taken us in at this convention where we have been treated royally, and never can forget it.

President.—Some of the members probably wondered why Mr. Mallard was not nominated for president this year, but having recently accepted a position as superintendent, I believe, in the operating department, he felt he would be so busy, especially for the first year or so, that he could n't possibly accept the presidency of the Association. I know I voice the thought of every one when I say that we are all sorry not to have Mr. Mallard elected president. He is a very agreeable and pleasant gentleman, and we all became endeared to him. Some of you might have thought it was queer that he was not nominated, that is the reason I make this statement.

President.—If nothing further to bring before the Association, I would say that we will plan to have a meeting of the executive committee in the city of Moncton. For the information of the executive members, we will hold a meeting of the executive committee at Moncton, 8 o'clock Saturday night.

President.—Anything further to be brought before the meeting?

Mr. Stannard.—I move that we adjourn to meet in Chicago the third Tuesday in October, 1904.

Mr. Pickering.—I second the motion.

President.—Gentlemen, before putting that motion, I think it is no more than right that we extend a vote of thanks to the representatives of the various publications that have always been very good to report our proceedings and give the gist of the convention to the other members not here. These first reports as gotten out by the press are very valuable.

Mr. Lichty.—I will make a motion that it is the sense of this Association that we extend a vote of thanks to the press of this city and to the technical papers and engineering papers which are represented.

Mr. Stannard.—I second the motion.

President.—You have heard the motion, as many as favor it please say Aye; opposed, Nay. The motion is carried unanimously.

President.—There is a motion that we adjourn until the

third Tuesday in October, 1904, to meet at Chicago. All those in favor of that motion will signify by saying Aye.

President.—The motion prevails, and we stand adjourned.

S. F. PATTERSON,
Secretary.

W. C. KIKENDALL,
Official Stenographer.

DISCUSSION OF COMMITTEE REPORTS

FOR 1901-1902.

CONTINUED FROM THE TWELFTH ANNUAL CONVENTION.

I.—Auxiliary Coaling Stations; Best Designs, Capacity, and Method of Handling Coal.

Mr. Snow.—I was a member of that committee last year and wrote a supplement to Mr. McGonagle's report, and I would like to give you a little appendix to that supplement. I described one or two methods of delivering coal to locomotives in that supplement, which were not covered by Mr. McGonagle's statement, and I have since concluded that another scheme might be of interest to any one who is interested in that subject, and it is this: The building of a large hopper which would deliver to locomotives by a chute operated much in the way that the ordinary chute is, except that it must have a valve to cut off the flow of coal, inasmuch as the hopper should contain seventy-five or one hundred tons. If the output of coal is say one hundred and fifty tons a day, or more, there should be two of these hoppers each provided with a chute. My idea of supplying these hoppers with coal from cars is by means of a grab shovel similar to what is used in discharging vessels. The shovel should be a little smaller, I think, than is commonly used for vessels; say about one-half ton capacity. This shovel can be arranged to be operated from an inclined or curved boom, so that a trolley engine will not be needed, and consequently only one man above and one below will be required to operate the outfit.

The coal supply cars should preferably be run up a trestle,

alongside the hoppers, high enough so that the trimmings of coal that the grab shovel will not take out of the car can be dumped into a hopper built just outside the track under the shovel boom. The trimmings are to be scraped into the side hopper, and when enough has gathered there it is to be picked up with the grab shovel and elevated.

If storage to the extent of ten or twenty days' consumption is desired, I would recommend a bin parallel to the tracks to be supplied by a gravity track fed from the large hoppers. This storage bin to be covered or open as may be desired. When it is necessary to take coal from this bin it may be delivered to engines either by derricks or some shoveling method.

Mr. Burrill.—As I understand Mr. Snow, he would have this coal bin put up without a cover or without a floor.

Mr. Snow.—That would be according to preference. If it could be afforded it would be much better to put a cover, sides, and roof over the storage bin, because there is more or less deterioration in coal stored out of doors, but everything of this sort adds to the first cost. It would be well to use it, and I would recommend it if you can afford it.

Mr. Burrill.—Would it not gather more dampness and be more liable to take fire if not protected by a floor underneath?

Mr. Snow.—I don't know, some kinds of coal will take fire and some will not very easily on the ground, but it might have a little tendency to collect dampness, not having a chance for the air to get to it that there is when on a floor.

Mr. Reid.—Along that line, while I do not have charge of the handling of the coal on the Lake Shore, being in a different department, will say we store on inclines to advantage, and we are now erecting a machine for handling coal near Toledo for storing half a million tons. The coal is dumped from an elevated trestle on a concrete floor, and we have a clam shovel which takes the coal from the pile and piles it back. It travels on a track and piles it back far enough so as to store about half a million tons. With the machine completed, and a track on the other side of the elevated track, will be able to store one million tons of coal to take care of

our coal supply in strikes and labor troubles. We have stored coal on the ground and on a plank floor, and so far as I can see there isn't any difference in the coal. After picking the coal up we put it into the chutes and the locomotives afterwards. I have never heard of any trouble with it.

Mr. A. S. Markley.—In reference to storing coal, we have always done so in the open air, where the space is entirely clear and ground level without any floor or cover. It is dumped there in the fall, and generally left there until after the miners have all settled their troubles with the operators, usually about May 1st of each year. We use a steam shovel for loading the coal at about two cents a ton, and with the aid of the section men to keep it cleaned up as fast as the steam shovel loads it we get very little dirt and do the work with very good results. This has been the practice for the last four or five years. In regard to coal getting on fire, have had no trouble in this direction. The coal does not lay very long, however.

Mr. Alexander.—I was present last year and spoke of our method of storing the coal. The question here to-day seems to be whether it is profitable to have a floor on the ground under the coal as a protection against spontaneous combustion. We store our coal in large buildings, which hold six to seven or eight thousand tons of coal, which are forty-five to fifty feet wide by sixteen to twenty feet deep, with floor under the coal. These sheds are filled in summer and fall of the year to last through winter. In one case we had fire in a coal shed by spontaneous combustion. Fire was from four to six feet in from side of shed and a little up from the bottom, about two feet. It did not get in toward center of shed as we moved the coal where the fire started so it was put out. We have had considerable heat in other sheds and to prevent fire have handled part of the coal over. I also knew of and saw a large pile of coal outside of a building and resting on a plank floor which took fire by spontaneous combustion, and it seemed to start near the bottom and eight or ten feet in from the toe of pile. It would not seem that resting on the ground would cause spontaneous combustion more than resting on plank floor.

Mr. Walden.—I have never had anything to do with taking care or storing coal, other than building the trestles so the cars could go up to unload from the trestle on the ground. In 1899 we unloaded a good many thousand tons of coal on the ground and it was not over six weeks or two months before we had several fires. Last summer we unloaded some coal near the bank of the Mississippi river, and that coal was covered over, but it caught fire in one instance. I have had fires in my coal houses several times during my time with the North Western road. We have a great deal of sulphur in our coal, but I do not know that there is much difference whether the coal is covered up or not covered up, but I think the quality we get in Iowa, if stored on the ground, might catch fire quicker on account of its having rained on it before it is covered. That is my experience, Mr. President.

Mr. A. S. Markley.—Twenty years ago we built a combined brick coal and pump-house. In a number of cases this coal would catch fire, when there had been no rain. We also put in a brick floor to keep the dampness out; but no improvement in that direction, and came to the conclusion that it depended upon the condition of the coal when put in, whether it would catch fire or not, and did not depend so much on the weather.

Mr. Reid.—I think Mr. Walden has struck the point as near as anybody else, that it depends on the kind of coal or the composition of the coal. I think coal with a great deal of sulphur in it will catch fire very much quicker, as sulphide is a very strong chemical, where you have it in coal in large quantities, and not to the change or effect of the atmosphere itself, and that is what generates it.

II.—Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expense for Various Classes of Railroad Buildings.

Mr. Snow.—Last year I submitted a little paper as a substitute for a report on this subject, and I would like to add our experience for the year which might prove of interest, perhaps, to some of the members. In regard to the cheaper classes of

roof and roof coverings, I made a statement last year covering quite a number of different kinds, and I find our practice lately is tending towards the two classes of roofing called Ruberoid and Paroid. Perhaps I ought to include one other brand, although we had an unfortunate experience with that on a roof not adapted to that kind of roofing, that rather gave it a black eye in our vicinity, but of the other two classes I name, we find them doing practically equal service. As to the still cheaper grades named last year, the three-plys, the two-ply, and the plain tarred paper, their life is so very short, unless attended to every one or two years, that we have practically abandoned their use.

Mr. Horning.—The Michigan Central is using some prepared roofing where shingles have given out, or proven to be unsatisfactory for any cause, and believe it to be giving good satisfaction. Have used it three to four years, and have placed it on roofs with pitch of eight inches to the foot. When substituting shingle roofs with the prepared roofing it is necessary in most cases to relay the roof boards in order to obtain a tight surface which can all be done with less cost than renewing the shingle roof, figuring the difference in the costs of the two materials, and at the same time obtaining a longer lived and fire-proof roof.

Mr. Lichty.—What kind of roofing do you use?

Mr. Horning.—Ready prepared gravel roofing.

Mr. Lichty.—I would like to ask if it contains any burlap?

Mr. Horning.—I believe it does not.

Mr. Lichty.—While I was on the Iowa division, the engineering department put up a new freight house at Boone, Ia., and covered it with a prepared gravel roofing, which, I think, was purchased at Waukegan, Ill. After it had been on about a year and a half, the tar and gravel came off in many places, leaving the burlap bare, and it became necessary to recoat the entire roof with tar and gravel. This was on a flat roof, slope about one inch to the foot.

Mr. Mountfort.—We have been using the Eastern Granite roofing for six or seven years. We covered a building 500 feet long and 45 feet wide with it. I covered this building

some six or seven years ago, and took a great deal of pains putting it on properly, and it has never given any trouble, and I am now using quite a little of the Eastern Granite roofing, and it is giving perfect satisfaction in every way.

Mr. Alexander.—I do not know that I have very much information to give. I spoke something about this matter last year. We are using, as I said then, the gravel roof chiefly on our engine houses, the ordinary tar and gravel roof, and I think it gives good satisfaction on flat roofs, but that, as well as other roofing has to be attended to, the same as any material. Some shingle roofs, we all know, will go a long time without repairs, others again will need repairs in six or seven years, and so we have been experimenting with other kinds of roofing. We have used Ruberoid for three or four years, and we have also used since that some Paroid for three years, and since that some Flintkote with good results so far, and even where some of it has wrinkled it has not leaked any yet, and I have had it in use three or four years, but that is not any test, not being on long enough. Five or six years is no test at all. We want a roof to last ten or twelve years and still be good, and then you have something that is good. This material, of course, is more fire-proof than shingles, and that is a benefit on small buildings and in many places, so that we like the roof very well if it only continues to last as recommended. I will say we are trying the different kinds to see which is best, and while I sometimes ask for Ruberoid and the company furnishes Paroid, perhaps on account of buying it a little cheaper, I am not possessed of sufficient information to return it and say that it is not as good as the other, though we will know some day which is the best, but have not had it on long enough to tell yet. A good deal has been said about the patent roofing, but not much about the nails rusting out and the roof coming off before being worn out, which occurs on engine houses mostly. I had charge of an engine house which had a shingled roof and when built they used wire nails. In about three years the shingles began to come off and I had them renailed with wire nails, but in about the same length of time the shingles began to come off again, and were

renailed. I have found the cut nails better for this than the wire nails. But the composition is better to hold good roofs.

Mr. Montzheimer.—I was going to ask if any of these gentlemen can give the comparative cost of taking off the shingles on a roof and fixing the roof boards, so this patent roofing Ruberoid or Paroid can be put on.

President.—Mr. Horning, can you give us the comparative cost?

Mr. Horning.—The last matter which comes to my mind is the case of renewing a shingle roof, occasioned by the shingle nails having rusted, and the shingles blowing away. A question came up as to cost, and in getting figures I found that 18-inch pine shingles, F. O. B., at the location of roof, cost $4.25 per thousand, and the prepared roofing $2.60 per square, and it was decided to use the prepared roofing as an experiment as to cost. The roof was an ordinary one third pitch peak roof containing 119 squares. We removed the old shingles, removed and relayed the roof boards, furnishing what new necessary to fill space of cracks and broken boards, making a complete roof at a total cost of $491. This figure is somewhat below what the 18-inch shingles could have been put on for. The cost of removing and relaying the shingles can be estimated from these figures.

Mr. H. P. Morrill.—I wish to give you some experience I had with engine house roofing. About 1888 or 1889 I put a tarred paper, pitch and gravel roof on an engine house, and the same roof is there yet and in very good condition. In the spring of 1898 I put a roof on an engine house of the prepared gravel roofing, and it is in very poor condition; it leaks very badly. This fall I asked a man for what he would put on 125 squares of the tar and gravel roofing. He said he would put it on for $4.50 per square, with a written guarantee for ten years. I told him all right, would try and get it done. I am in favor of a tar and gravel roof for durability.

Mr. Penwell.—I have had some experience with the Granite roofing and would say that we have had considerable trouble with it on account of leaks, though I do not care to condemn the quality of the roof on that account, as I think the trouble

might have been in not putting it on properly. Cheaper roofs do not give very good satisfaction. The last thing we did before I left home was to let a contract for 150 squares of built-up pitch and gravel roof at $4.50 per square, and last week we let a contract for 51 squares of tile roof at Lima, Ohio. We favor the tile slate and the old-fashioned built-up pitch and gravel roofs. They excel anything we have ever tried for durability.

Mr. Carpenter.—I want to give you a little of my experience with a tar and gravel roof. My experience has been largely, in fact mostly, with this class of roofs, and I know in some cases the sheathing boards were what they should not have been, but it seems in the past that it was the opinion of a great many that most anything would do for sheathing, and that we expected a contractor to come along and guarantee a roof for five or ten years with nothing to lay the roof on, the sheathing boards not being of proper thickness, and full of knot holes, etc. I think a great deal depends on having a good foundation to put your roofing on. You cannot get a good roof unless you have good roof sheathing prepared for it any more than you can get a good permanent building unless you get a good foundation. Sheet-iron roofing, I think, is a thing of the past. In my experience I have never found it durable, no matter how particular you are in painting it. My best experience with sheet-iron roofing was to buy it black and paint it myself, but I am rather inclined to think that paper is the coming roof for general use on depot buildings.

Mr. Swett.—Would like to ask how this Ruberoid is fastened to the sheathing, that is, what the general practice is?

Mr. Carpenter.—The little patch that I have is nailed on with nails, spaced about four inches apart with a tin cap and lap of two inches. It is thirty-two inches wide. We lap it two inches, which leaves thirty inches exposed to the weather.

Mr. Steffen.—I would like to add to Mr. Carpenter's remarks that the agent of the Ruberoid company very recently called on me and explained that the latest method is to furnish a small nail with a washer, such as Mr. Carpenter mentioned,

but the lap is not sufficient to cover the nail heads. They do that by cementing the edge of the material that joins the nailing strip, making absolutely a tight joint.

Mr. Alexander.—The question has been asked about putting on this roof, and some of the answers are not according to instructions. The Ruberoid people say to nail the roofing so as to have a two-inch lap, cement it well, drive the nails two inches apart with a tin cap, and paint over the nails and the tin caps with a cement that they furnish. When this is properly done you have a good joint and do not have any rust about the nails. They use a first-class cement, I will say that for it, but as Mr. Carpenter said about roofing, we want a good surface to put that roof on, just as well as any other, and without that you cannot have a good roof. I believe the secret of having a good roof is to make a good surface for it and put it on well.

President.—Some four years ago I covered an engine house, an old flat roof, with a prepared roofing, and I was very particular to follow the directions explicitly and put the cement on and covered same immediately, following up immediately so that the cement would not cool. The first season it was tight and I congratulated myself that I had a good roof, but it has never been tight since. That roof would leak in one place in one storm and in another place in another storm.

Mr. Large.—In reference to the difference between the cut nail and the wire nail, I think it all depends on the material. I would like to say that some time ago I changed my mind and went back to the cut nail, but I had just exactly the same results with the cut nails that I did with the wire nails, neither of them appeared to suit the purpose, just rusted off, and the shingles blew away, and that's all there was to it and nothing left but a black streak in the sheathing. The iron nail, as originally made, was a good nail, but you cannot get the good old fashioned iron nails any more. I think the best nail would be a composition nail, something that the acids would not affect.

Mr. Killam.—My experience has been that if you put a roof on with cut or wire nails, where there is a damp atmos-

phere under the building, or on an engine house, where there is steam and acids, that they will last only two or three years, but a galvanized nail will last for years and years. I am building a house for myself, and in place of paying $2.75 I pay $5.00 per keg for galvanized nails, as they are the cheapest for a roof.

III.—Mail Cranes, First Cost, Efficiency, and Maintenance of Various Styles in Use.

Mr. Reid.—Since the time of the last meeting the Lake Shore has brought out a new mail crane, and we are using it where we have four tracks. It is an iron crane, of which I have a print here. It costs about $35, at least that is the cost as near as we can tell. It is made partly of wrought iron and partly of malleable iron.

President.—I wish you would kindly give that print to the secretary, so it can be included in our proceedings.

Mr. Reid.—I will be glad to do so.

Mr. McIntyre.—In talking of mail cranes I think some ingenious member here should be able to get up some patent that would either lower or raise the mail crane arms, so they would not endanger the lives of the engineers, as I know of several instances of engineers being struck by mail cranes. I think there ought to be some way to overcome this and probably the best thing to do would be to put the arms overhead, up above the engineer.

Mr. Penwell.—I am thinking some of that matter myself. We have suits just at the present time, on account of a brakeman and a fireman getting caught in these cranes.

Mr. Carpenter.—I am using quite a number of the Columbia mail cranes, and I believe that I have less trouble with them than any other crane I have ever used, but when our present company bought the road, the Southern company, they sent me a standard plan for their Standard mail crane, and I have had a half dozen or so made, and I believe the irons were not heavy enough, and in some respects and in other particulars the springs were too rigid, but by experimenting and substitu-

ting heavier irons in some cases and lighter springs, I have overcome about all the trouble. I believe the Columbia mail crane is about the best crane I have come across; it only requires two long ties to go under the track, while our Standard requires three, making it expensive.

Mr. Large.—We have on the division that I am connected with two makes of cranes. One is a regular government Standard and one that we manufacture ourselves, and they both give good satisfaction, but I would rather favor the Columbia from the fact that it takes up very much less room than our Standard that we manufacture. Recently we have had orders to lower the arms of the cranes to the lowest possible point at which they could catch the mail to avoid the trouble about the enginemen getting struck. We have experimented with a couple of them, that I have had in use now about four months, and no trouble reported of mail being missed, so that I rather think that we have lowered the crane to the lowest possible point.

Mr. Montzheimer.—On page 148 of last year's proceedings there is a cut showing an automatic mail crane that I invented. I think we discussed this subject last year, and that it is not necessary to say anything about it now, except to say that it is of iron construction and turns automatically from the track when the bag is taken, making it safer for train crew on following train. About twenty-five of these mail cranes are now in use on the North Western road. They are securely fastened to two long ties, which gives them a good firm foundation, and this also always keeps them in good adjustment with the track.

Mr. Alexander.—Last year this subject was up and I believe I stated that we used a wooden crane when the matter was up for discussion. It is a wooden crane that we build ourselves, government standard, or such that the government approves of, and we have had little trouble with them. I do not know of any accident to engineers and very seldom fail to catch the bag of mail, and they work very well with but ordinary light repairs. As to the matter of engineers getting struck with them, we have had some cases where they came very near it, and had very close calls, and such cases were in this way. Near the stations, usually, those mail cranes are placed, if

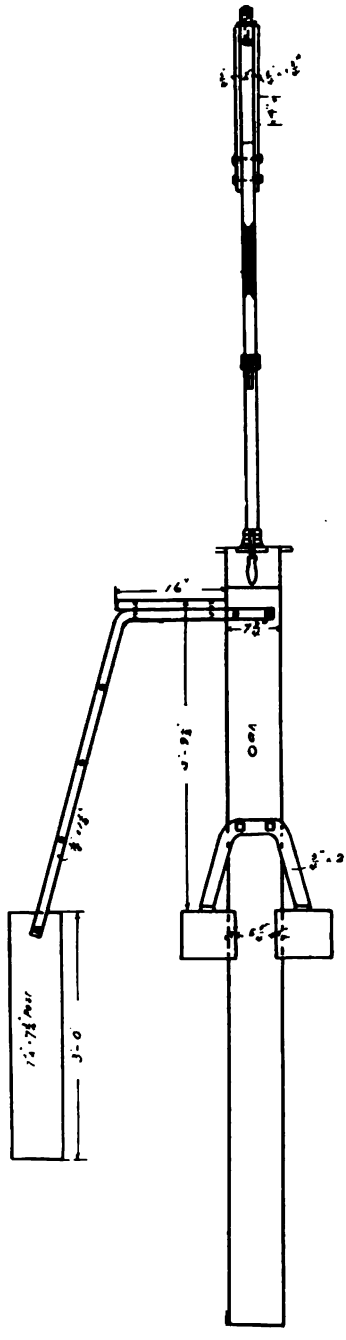


Fig. 8. Front View Standard Mail Crane, L. S. & M. S. Ry.

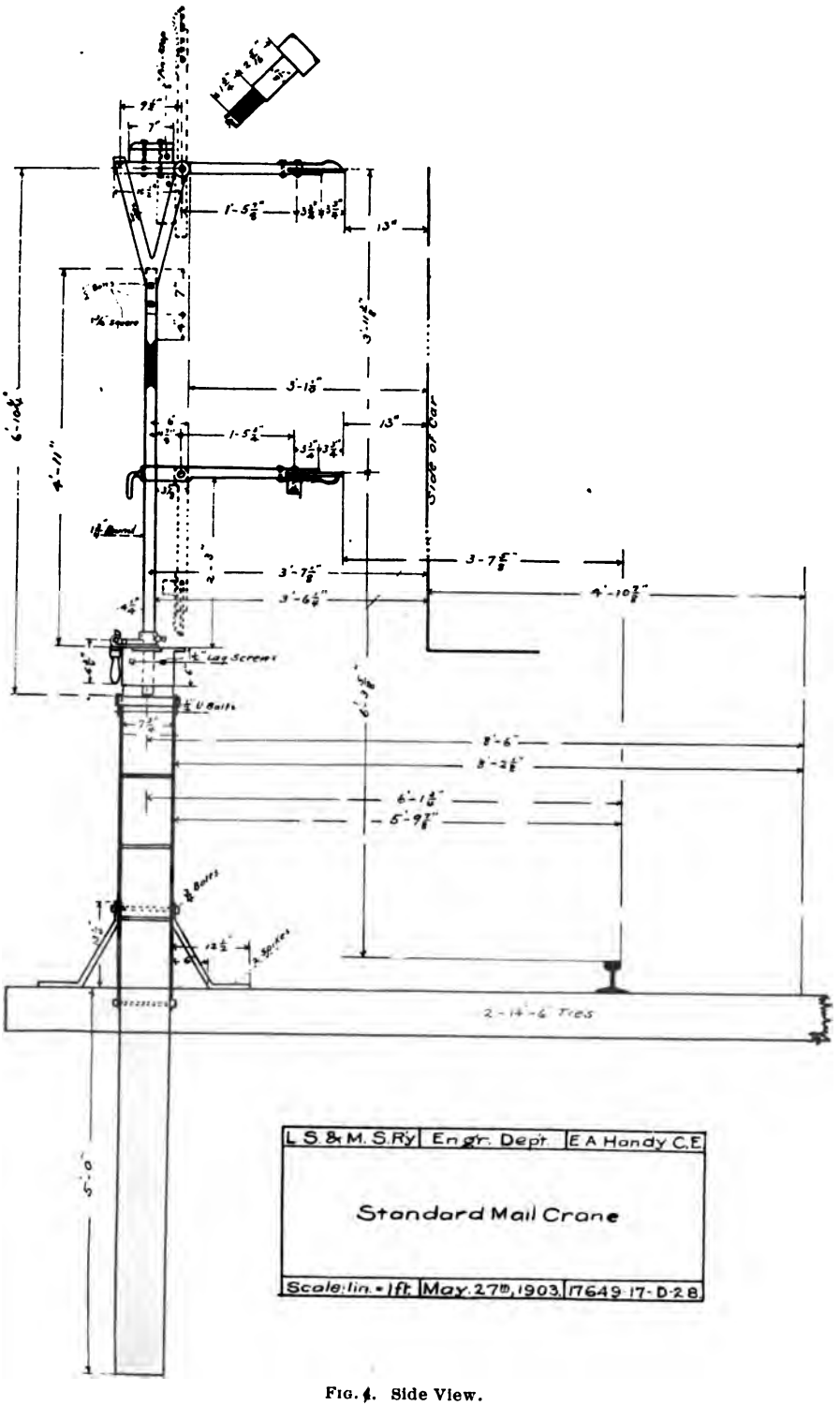


FIG. 4. Side View.

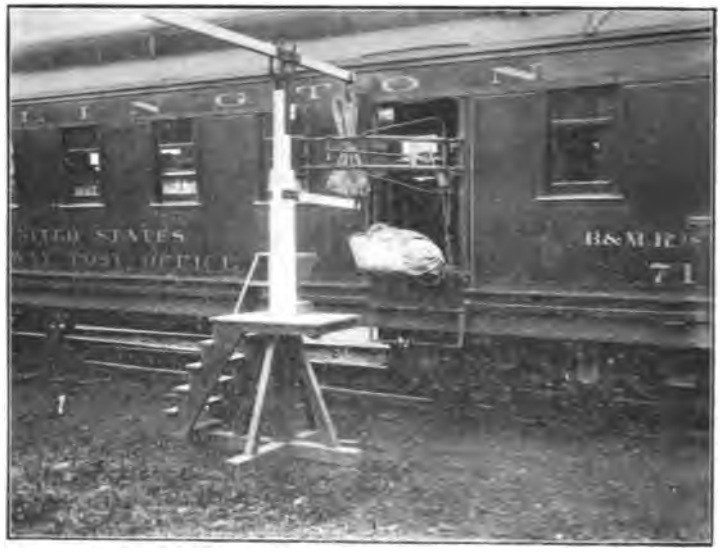


FIG. 5. Taking the Mail—Patten Crane.

FIG. 6. Mail Delivered—Patten Crane.

possible, in a place a little ways from the platform, and as a train goes past that does not stop, the engineer looks back just as he passes the station, and when he throws his head out he is liable to strike it.

Mr. Horning.—Referring to accidents, we have not experienced any great trouble in hurting people in this way, but have had a little trouble from the falling of the mail bag when thrown from the car, and to overcome this difficulty we have caused signs to be printed and placed on posts, and set them in places where the mail sacks are to be thrown off, as a warning to pedestrians.

Mr. Burrell.—I believe the Burlington company is making an experiment for both delivering the mail and for the picking up of the sacks that might give valuable information on this subject.

Mr. Burrell (by letter).—In accordance with the suggestion of the president for me to obtain data for publication in the Proceedings as to the mail crane and catcher and delivering device used on the Burlington lines in Nebraska, I have investigated and find that the device is patented by S. R. Patten, Omaha, Neb. I enclose two photographs (see illustration).

This mail crane consists of a mast post and arms of regulation height and length. The top of mast post is provided with wrought iron supports for the top "hanger arm." The top hanger arm is pivoted in these supports, and when not in use stands perpendicularly. About three and one half feet above the platform is a short hanger arm, pivoted to the mast post, that is used in connection with upper arm for holding the mail pouch in position. When not in use this arm hangs down. An examination of the photographs will show the crane and perhaps give a better idea than a written specification. The leading feature of the device is the catcher and pouch delivery. The catcher consists of two strong malleable iron rods, parallel to each other, pivoted on side of mail car door, at a fixed height, to conform to proper height of mail pouch when hanging in position for catching. Between these parallel bars is a round iron bar with the inner end forked and pivoted to a round rod that works as a piston, one end being secured on the

side of the door opposite the pivot or hinges of the main part of the catcher; the other end is secured to the main part by a brace near the gudgeons of catcher. There is also a tripper at the inner end of the catcher that releases the pouch carrier on the "deliverer." This "deliverer" consists of a wrought iron grate on the side of the car and is level with the car floor when ready for use. It is held in position by chains secured to the tripper by a hook.

When a pouch is caught it trips the delivering device and drops the pouches near the mail crane; never more than fifty feet away. The only preparation of the road-bed necessary for delivery is that a slight incline be furnished so that the pouch will roll away from the track.

I should mention that when the catcher receives the pouch from the crane, it (the catcher) closes against the side of the car. This prevents the pouch from falling out of the car.

By this catching device there is no tearing of pouches or breakage of packages. Any weight can be handled by catcher and deliverer.

This device has been in regular use on certain mail train runs on the Burlington System in Nebraska for several years.

VII.—Best Material and Designs for Roundhouse Pits, including Drainage and Rail Fastenings.

Mr. Snow.—I would like to ask for information in regard to the depth of roundhouse pits. With us I have found that the motive power department does not require such deep pits as they used to. They do not have to work underneath the engines so much, and, if I remember correctly, we find twenty-four inches at the high end of the pit is as deep as the motive power department cares for at present; then we give them a little pitch, so that the other end is probably thirty inches deep. I would like to know if this is the general practice.

Mr. Lichty.—I would like to say, in addition to the remarks that Mr. Snow has made, that we find it as he states; that the pits need not be as deep as they formerly were, and think, for my part, it is much better to have them of a less depth.

Mr. Carpenter.—I would be glad to give you some of my

experience. Two years ago, or two and a half, I put in an engine pit and a drop pit combined. I built it out of concrete. We can run an engine over that and drop any pair of drivers we want to drop. We have had good success with that. Made it water tight, and have had no trouble with it. Last spring I built a double-drop pit. I can drop wheels from one track and bring them up under another engine. We built it out of brick. That was a test to try that with brick, and we got a fair job and as far as I know it does not leak. I was very careful to see that the brick work was done in what we call the "push" method, but, in my experience, it was about the first one built of brick that we ever made a success of. I think concrete construction is the best; in fact, I am a concrete man.

Mr. Lichty.—I would like to ask if Mr. Snow has any figures for comparison between the cost of brick and concrete for that kind of construction.

Mr. Snow.—In answer to Mr. Lichty's question, I would say that a couple of years ago we made a comparison for constructing a drop pit of stone, brick, and concrete, and we found that steel concrete was the cheapest. We built it that way, and were so well satisfied with it that the next year we built another one the same way and had no trouble with it. We reinforced the walls of these pits with steel rods, so that the whole thing was really a scientifically designed retaining wall of steel-concrete construction. The pits stand perfectly, and were cheaper than if built with brick walls.

Mr. Burrell.—I would like to ask Mr. Snow what class of brick he uses, and about the price per thousand as to the difference in the cost of concrete and brick. Do the local conditions make the difference? Do you use paving brick?

Mr. Snow.—The estimate was based on common building brick, worth $15 to $16 per thousand laid on the ground. The saving came from the volume of the concrete work. The walls, being reinforced with steel, were very much lighter than we would have had to make a brick wall, because with a brick wall you could not reinforce with steel in that way. The walls are eight feet high, and I do not remember what thickness we

figured it would have to be if built of brick, but I think it was about three times as much volume as we put in of concrete.

Mr. Burrell.—If brick could be obtained for $8 per thousand, would you advise brick?

Mr. Snow.—I would take whichever was the cheapest.

Mr. Alexander.—This matter of engine house pits, I do not know that I have very much to say on them, yet it is something that we can all say a little about. We last year, I think, talked on this, and I do not know but what some plans were submitted of the same kind of pits we have built. Mr. Burpee, here, has been our designer for the pits that we have built for some time. We build concrete, with a convex bottom, as spoken of in the report last year. For our rail fastenings we use an 8x12 hard pine sleeper laid under the rail, and spike directly to that, and we find it very satisfactory. There is another matter that I might speak of; that is, we find a good deal of trouble in draining our pits. We drain them to one sewer, and you know it happens that sometimes you can make things to use, but it is pretty hard to make everybody use them right, and they frequently allow all the waste, etc., in the pit to enter the sewer, and the first thing you know you get a telegram to send some one to clean out the pit sewer, because plugged up, and sometimes they even tear out the strainer or the grating in these pits because the water does not run out fast enough, thus causing the sewer pipes to get clogged up with refuse and unnecessary expense in cleaning out the pipes.

Mr. Montzheimer.—I have had a little experience in that respect, but I have found out who the men are that do it. You go around in the day time, and you will find that it is the night men that do it, and you go around at night time, and it is the day men that do it, so it is very easy to tell who does it. In the report we recommended a large catch basin to catch the refuse material in these sewers, because even with your strainer, if it is never disturbed, the thick wash stuff that comes out of the locomotive boilers, especially where washed out with soda ash, will plug up a sewer very quick, but by means of this catch basin it will enable you to clean it out.

Mr. Burpee.—I think possibly Mr. Alexander has led you to think that our sewers are a little bit too small, and that is the conclusion I have come to myself. In regard to the construction of our pits, I do not know but what some of our friends here would think that we are wasting a good deal of Portland cement by making a wall which is two feet to two and a half thick at the top, but I would say that we use a good many "plums" in our concrete. These are simply small boulders, and where you have a wall say eighteen inches, we use small boulders, in size about nine to ten inches across. By using these "plums" you can reduce the quantity of the cement very much, and you will have just as good a wall. In a good deal of my heavy concrete work I have not only permitted it, but insisted on their use. The cement is rather costly, and we cannot afford to waste it. I do not know anything about the use of steel concrete, never had any experience with it, but I do not see where a little steel rod in a body of concrete does much good. I do not mean to say that it will not, but I have not been able to understand how a little rod will increase the strength of concrete, and cannot see where it helps very much.

Mr. Montzheimer.—It don't make a great deal of difference how large a sewer you have, it is only a matter of time until they stop up if not taken care of. We had a two-foot brick drain for a roundhouse of about twenty-three stalls, as I remember, and we had trouble on account of that sewer getting full of soft mud.

Mr. Lichty.—At North Fond du Lac, Wis., we have an engine house with eighteen stalls, constructed in 1901. It has leading from it a twelve-inch sewer, with a length of about 1,000 feet. When constructed there was only one small manhole near the engine house, entirely inadequate for the purpose of a catch basin. There was not another manhole the entire length of the sewer. Within two years this sewer became clogged with waste, cinders, and boiler washings, and it had to be cleaned the entire length. We put in a large catch basin near the house, making it considerably deeper than the sewer so that it would catch all the rubbish, and put a

screen over the outlet so that floating debris could not enter the sewer. We then put small manholes in the line of the sewer, about 200 feet apart, and cleaned it out with the aid of sewer rods and by dragging a heavy chain through it, and since that time it has caused no trouble whatever. The main difficulty is obviated in the large manhole near the engine house which is cleaned out, as often as necessary.

Mr. Burpee.—I think the secret of the whole thing is to build it well and then look after it. That is where we are at fault, expecting these things to run themselves. I want to say in this connection that I think there is some danger in getting a sewer too large. What I mean is, though it should be large enough, it is true, it does not want to be so large but what the water running through it will pretty nearly fill the pipe.

Mr. Large.—This is a matter I have considered in regard to sewers, and I am of the same opinion as Mr. Burpee; that it is possible to get a sewer too large. I think a sewer that will carry all the water that is required to go through it is better than a larger one, from the fact that the water passing through these sewers creates a current which has a tendency to keep the sewer clear, whereas, if your sewer is too large, the water only carries off part of the accumulations and finally it will get clogged up.

Mr. Markley.—We have adopted the use of the plumber's rod; get them from 75 to 125 feet long, ¼ by 1½ inches wide, coiled up like wire to carry. We run them through the sewers to dislodge the sediment, with good results.

Mr. Killam.—This discussion in reference to sewers or the drain pipes getting clogged up is rather an important matter, no doubt; however, with us, I do not know of any experience of that kind. We have a roundhouse built in the year 1871, and another one, a 24-stall roundhouse, built some fifteen years ago, and another one, twenty-eight stalls, which has recently been enlarged to accommodate the larger class of engines, and the sewer, I believe, is a 2-foot sewer, and although it has been down thirty-one years, I never heard tell of its being plugged up. It was built with a view so that it

would never be plugged up. The grade I think is 1 per cent., and it is 1,000 feet long, and has never been plugged up. I would add that the drain of the yard goes through this sewer.

Mr. Burpee.—I would like to ask Mr. Killam if this is a circular section sewer?

Mr. Killam.—Yes, sir.

Mr. Burpee.—The drain of the yard has something to do with keeping it clean?

Mr. Killam.—Yes, sir, that helps it.

Mr. Ingalls.—I would like to ask Mr. Lichty if he has to clean that catch basin he spoke of?

Mr. Lichty.—We have to clean it every two to four weeks.

Mr. Edinger.—I notice around pits there is always more or less trouble where a wooden stringer is used for a rail rest, and for a number of years we have been using a concrete stringer altogether, bringing the concrete right up under the rail and using base plates 6x8x$\frac{3}{8}$ inches for rail supports, which are fastened down with anchor bolts and clamp clips, and this proves very satisfactory. We never have had any trouble with them, and they are certainly much more durable than a wooden stringer.

Mr. Montzheimer.—In the committee's report of last year you will find a description of a very good iron plate for fastening rails on pit walls built of concrete, and by building pits of concrete and using iron base plates for fastenings, instead of wooden sleepers, you get permanent construction. It is a mistake to use timber on top of pit walls. I noticed at the new Canadian Pacific shops at Montreal, yesterday afternoon, that there is a great deal of timber being used, and it seems to me they are going to have a lot of work to do in future years. Good timber is expensive, and if they used a base plate it would have fixed that for all time.

Mr. Ingalls.—Mr. President, we use concrete sills for roundhouse pits and they give good satisfaction, and have never had any trouble.

Mr. Edinger.—As fast as our wooden stringers have decayed on old pit walls we have taken them out and put on concrete stringers, and find them better in all respects than the wood.

Mr. A. S. Markley.—In building our shops at Oakdale this year we did not put anything on the machine shop pits but anchor bolts and clips for holding the rail down.

Mr. Edinger.—We have tried bringing concrete up to the top of the rails on the outside of the pit to hold the rail in place without using base plates, but in nearly every instance the concrete split out and the rail worked loose and rocked on the concrete, destroying it entirely.

Mr. Burpee.—Would like to ask Mr. Edinger what distance apart the bearing plates under the rails are placed, which, I understand, are 6x8x$\frac{3}{8}$ inches. Would like to know how far apart they are.

Mr. Edinger.—About 24 inches on centers.

VIII.—Best Materials for Wearing Surface of Roadway of Highway Bridge Floors.

Mr. Large.—Where I am located, do not have very many overhead bridges; have a few, but have not gotten beyond the point but what we can get along with plank so far, as on the few overhead bridges that we have there is no great amount of travel. Thus far we have been using a double thickness of plank, renewing the top course whenever it wears out.

Mr. Miller.—I would say that we have a number of overhead bridges on my division, and use yellow pine for the decking, 6, 8, 10, and 12 inches in width, covered with paving blocks, cut to 6 inches, or 6$\frac{1}{4}$ inches, depending entirely on the height of the street-car rail. The life of paving on our viaducts in Chicago is only about three years until the paving is worn out. It seems like that is a very short life for a paving block, but the travel is so extensive that it simply wears out a 6-inch paving block in from two and one half to four years, depending upon the traffic over the viaduct.

Mr. Snow.—I would state that we have quite a number of paved overhead bridges. Some of these are paved with stone and some with brick. The life of stone paving is indefinite. It may wear out some time, but not within the lifetime of the man who put it on, probably. In order to put this paving on a so-called water-proof floor, we put down over the plank floor-

ing a foundation composed of four layers of tarred paper, laid in the ordinary manner, and on top of this we put 1 inch of coal-tar concrete, and on this a 1-inch bedding of sand. On this sand the stone or brick paving is set, and the joints to within about 1 inch of the top filled with clean, coarse pebbles about ½ inch in diameter. After the paving has been properly rammed, the joints are filled with hot coal-tar pitch, the pouring being repeated until the joints are full. In some cases we have used cement grout instead of tar. Of course this kind of pavement is what would be required in a place like Chicago, or in a place where there is heavy traffic. Our country bridges we plank over, as Mr. Large has spoken of.

A Member.—I beg to ask one or two questions in reference to the kind of material or blocks used, and would therefore like to ask Mr. Snow what kind of stone is used, and what is best, in his opinion, to prevent them wearing off and becoming slippery? Whether the sandstone or granite is best to use?

Mr. Snow.—The practice on the bridges I mentioned has invariably been to use granite stone paving, because granite is our only material for stone paving. On a few bridges we have used brick.

Mr. Steffen.—The city of New Haven, Conn., has used vitrified brick paving on heavy highway bridge construction with excellent results, I believe. Granite block pavement, however, laid with pitch and gravel joints on a cushion coat of sand, is still the most satisfactory form under heavy traffic. It may be supported on buckle plate on brick or concrete arches, or, as in the case of one bridge in Boston, on creosoted wooden joists and plank floor.

Mr. Aldrich.—In Boston we have several street bridges over our tracks which we have filled in with cement concrete with what we call a granolithic wearing surface. These bridges have been in service four years, and are in good condition yet. We have other bridges in the same locality, with practically the same amount of travel, covered with 3-inch under plank and 2-inch wearing surface. We have renewed some of the wearing surfaces as often as three times in a year.

COMMITTEE REPORTS

FOR 1902 AND 1903.

PRESENTED AT THE THIRTEENTH ANNUAL CONVENTION, QUEBEC, CANADA, OCTOBER, 1903.

I.—Best Falsework for Rocky Bottoms in Rapid Currents where Piles cannot be Driven.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on subject No. 1, "Best Falsework for Rocky Bottoms in Rapid Currents where Piles cannot be Driven," respectfully submits the following report:

Circulars were sent to each member of the Association, requesting,—

1. An elevation sketch of horse or bent which is considered advisable in case of a washout.
2. Best method of placing horse or bent in position in case of a washout.
3. An elevation sketch of horse or bent which is considered advisable in rebuilding bridges or erecting new structures.
4. Best method of placing horse or bent in position for rebuilding bridges or erecting new structures.

Replies received, omitting some which practically describe work as outlined in other reports, are given below.

James D. Gilbert, General Iron Bridge foreman, G. C. & S. F. Ry. I have had some experience in this particular line of work and the best and only way I could find was to use long piles and drill a hole where piles are to be located, and put in a light shot of dynamite and blow out a place large enough to set the big end of pile in the hole.

I used 55-foot and 60-foot round pine piles, 6 piles to bent, 22-foot C. to C. of bents, having bents under panel points of new span, using 12 in. x 12 in. x 28 ft. for caps and using 12 pieces 7 in. x 16 in. x 28 ft. to carry span and track, and 2 pieces 7 in. x 16 in. x 28 ft. on each side for traveler run.

I floated most all the piles and picked them up and set them in place with hoisting engine, and in addition to blasting out a hole in rock, I bolted a 12 in. x 12 in. x 3 ft. on the up stream batter pile and one on the down, and bored a 2-inch auger hole through the 12 in. x 12 in. x 3 ft., used a piece of gas pipe and drilled holes in rock and anchored each bent with 1¼-inch anchor bolts. There were several rises in the river, but my falsework stood all right. I had to use a jet to clear the sand away from several of the bents. By using the long piles and bracing them well, you can use the same material a number of times, taking the high bridges first.

I am sure if you try this plan you will find it very satisfactory.

Mr. J. S. Berry, Supt. B. and B., St. L. S. Ry. The way I place bents in rocky bottoms is to drill out the rock the size of the pile to be driven, to the depth of about four feet, drive the piling down tight and then fill in around the piling with grout,

so there will be no chance for the water to get in around the piling. I then bolt a sash brace on each side of the piling and swaybrace the bent. This will stand any current, drift, or anything else that may wash against it.

M. Riney, Supt. B. and B., Madison Div., C. & N. Ry. First: Under separate cover I send you sketch of crib built out of 3 in. x 8 in. hemlock.

Second: Build crib on shore or up stream side the size desired; float it to bridge site; sink it by building up to the height desired above high water and fill crib full of stone; if round boulders are used, you will be able to get a good safe bearing on the bottom for crib. Finish top of crib level for placing the frame bents.

Third: Such a foundation is safe to maintain traffic. Remove the old structure and erect the new without any question.

S. F. Patterson, B. & M. R. R. My way is to reach out 15 feet ahead and set up 4 legs (one at a time) with two braces, nail on stays, get the height, saw them off, put on a cap, move ahead, and continue doing so until I get across, working at each end of the bridge, when I can get material and men to do so. I usually put in legs barefooted when we do not drive piles, especially if it is a hard or rocky bottom. Would use a steam derrick car to place the legs when I could get one.

G. W. Smith, Manager Erecting Dept., American Bridge Co. Conditions are so variable that I do not see how you can determine upon anything that will fit all cases, and I will therefore assume first, that the bottom of the stream is not smooth ledge rock, but, as is usually the case, consists of broken or shelly rock which has come from ledges in high ground along the stream. In such cases a good cast iron point usually proves that piles can be driven although the bottom may be classed as one in which piles cannot be driven. I found this to be true in so many cases that I consider the cast iron shoe worth trying in every case except smooth ledge rock.

Supposing the case to be one where the bottom is positively impenetrable, I will answer your questions in the order in which they are stated in the circular, except that I can give you no sketches.

1. The best type for use in case of a washout is a heavy bent with double sills and double caps which can be sunk and held down by attaching pig iron, rails, scrap iron, or anything else available. At each end of the sill a 2½-inch hole should be bored vertically, and in the top of this hole should be inserted a piece of gas pipe long enough to reach out of the water when the bent is sunk. Through this gas pipe and hole in the sill a drill can be operated and dowel set in the ledge rock. The floor timber used should be as long as the loads to be carried will permit, so that the bents can be more than 16 feet C. to C. The double caps and double sills, together with an extra number of posts,

will distribute the load so that if a bent gets a bearing on two or three points it will be perfectly safe. An essential feature in such cases is the insertion of struts 3 x 8 or 4 x 8, for example, between the posts. A set of these should be spiked on under side of the cap and on top of the sill. Intermediate between the cap and the sill there should be one or two sets according to the height of the bent and the nature of the situation as to ice, drift, etc. I am assuming, without going into detail, that the bent is heavily and solidly braced.

2. Answer included under No. 1.

3. Various designs are suitable for rebuilding bridges across such streams, and any type of timber construction is a makeshift at the best under the circumstances. One type consists of bents located in spans alternately 6 x 18 feet C. to C. The 6 foot panels are enclosed to form a crib which is loaded with rock. The stringers in such a case must be 24 feet long. If the load will permit the open space can be made longer by using 28-foot or 32-foot stringers. This is probably as good as any design for the timber structure.

4. In building such a structure as I have mentioned in No. 3, a low water season is usually available which will permit the sinking of the bents without any difficulty.

I appreciate the fact that this reply may not be satisfactory and shall be very much pleased indeed if there is a single suggestion of value in it.

The price of material and the amount of the traffic on nearly all the railroads in this country at the present time warrant the use of masonry and steel in cases of reconstruction. Consequently, it seems to me that about the only design which our Association needs to discuss thoroughly is the temporary structure for use in case of washouts. I believe the proposition in my statement above or some modification of same is a satisfactory solution of the question. When conditions will not permit the adoption of that plan, the best way is to wait until the water goes down. If the traffic on the road is so important that this is not permissable, there ought to have been a structure there in the first place which would not wash out.

J. P. Snow, Bridge Engineer, B. & M. R. R. Replying to circular letter dated March 17, 1903, I beg to submit a sketch showing cross section of trestle and plan of stringers that I would recommend for use in case of a washout under the conditions named in subject No. 1.

If the water is too deep for men to keep their footing in, a float stage 8 or 10 feet wide and 12 or 16 feet long should be made of dry timber, and held at the site of the trestle by a long line anchored up stream. This raft is kept in front of the last bent set and can be held by light stays so that its front edge is about right to guide the posts of the next bent to be placed.

The 6 in. x 6 in. spruce or white pine joists or round poles about 32 feet long are run out over the ledger plank A till they

project about a full bay ahead of the last bent set and their rear ends chained to the second bent back and a few short plank laid on them so that posts for the next bent can be carried out and set in place, the men on the raft setting them in the river bottom in the best places that they can find among the rocks. If the bottom is such that they cannot be set in line where desired, a shorter span must be adopted. It is not essential that they stand exactly square to the line, but the four posts of the bent should line up among themselves. The posts are spaced and battered as near as may be according to the plan, and the water-line girders spiked on by the raft men, and a single 2-inch ledger marked A and two longitudinal stays put on by the top men. At this stage the posts are as shown by the right hand side of the sketch. The raft is set forward, the poles projected ahead, and another bent set in the same way. Staging plank are laid on ledger A, another set of men cut off the posts and place the caps and others run out the stringers, ties, and rails. The caps may be drift bolted to the posts or held by 2-inch plank battens spiked to the posts and cap. The stringers may be drift bolted to the caps or held by a notched plank spiked to the side of the cap. To hold the bents to the stringers longitudinally, chocks can be spiked to the underside of the stringers abutting against the caps. For strictly temporary work it is not necessary to use so many drift bolts as is often done.

Sketch B shows a method of staying caps and stringers without drift bolts. Battens are needed only on one side of the cap, and with a little forethought they can be put on so as not to interfere with the sway bracing.

When the work described above has been carried across the opening, trains can be passed at slow speed. To make the trestle safe for regular traffic, ledger A and all staging plank should be removed and sway braces spiked or bolted on, as indicated by dotted lines. Longitudinal X braces or horizontal runners abutting against the banks should be put in to hold the bents vertical and to prevent the posts from buckling if the height is over 16 or 18 feet.

The sizes of timber and the spans recommended are suitable for 80-ton engines. Heavier loads would call for shorter spans. The stringers are lapped instead of being butted on the caps to save time and timber. Moreover, if the stringers are butted the caps should be larger to provide more bearing, in which case the sway bracing would not fit on so well. The ties are common sawed track ties. The posts may be round timber if square cannot be obtained, but if round there should be six per bent unless they are 12-inch diameter all over.

In getting down the banks, if a pile driver is not available, a space can be shoveled out where the bent should stand and a sill bedded on the firm ground if the bank is regular, or a plank platform built for each pair of posts if the bank is skew to the line. A moderately small platform will suffice to carry the load.

Sighting across the ledger boards is exact enough for sawing off the posts. If this part of the work needs to be done at night, lanterns can be fixed for ranges and a lantern with the wick turned down, so that the blaze is small, used for a target on the level board.

If it is desired to build the trestle for double track 6 posts will answer, although in that case 10 x 12 posts should be used under the inner rails.

Falsework, for erecting a new bridge or taking down an old one or both, may be built in much the same way as above described, except that generally for single track 4 posts should be used under the track and one or two more under each truss. Two essential features in building falsework that will later be used for erection that are often overlooked are: That the caps be low enough to be well below the chords of the new bridge so that ample stringer sticks can be run to support the chord at the panel points, and that the caps be long enough to carry a traveler outside the trusses. Frequently the track must be carried on a low supplementary trestle set on the regular caps. When this is done the caps or heads of posts should be strongly secured longitudinally by runners to keep them from jack-knifing at the caps.

For carrying the traveler it is frequently cheaper to set a long brace timber under the projecting ends of the cap than to put in an additional post.

F. Ingalls, Supt. B. and B., Dakota Div., Northern Pacific Ry. While I have had charge here for twenty-one years, and have had all kinds of washouts and water trouble, have had to use bents but twice. The first time was in '93 in ten feet of water with an eight mile current and full of ice from two to three feet thick, where riprap around pier would not permit of driving of first bent. At that place we used a common frame bent with sill and cap and 4 posts, outside posts having batter of 1½ inches to the foot, and we planked up the sides for 3 feet from bottom and between the planking filled in old castings (from washed out span) and stones, to give necessary weight to sink the bent. This filling was done after bent was in water and held in an upright position by line from leads of pile driver.

The second time was a year ago, where on account of 1¼ miles of track being 2½ feet under water for over two weeks, we built a temporary track and crossed at a narrow point about two miles directly north. At the crossing we put in a temporary bridge 600 feet long in 8 feet of dead water; the material for which all had to be hauled 4 miles by teams to the point of crossing. For this bridge I used the same kind of a frame bent as we did before, framing the bents on shore and floating them out to where they were wanted, raising them to an upright position by a hand line run over a 3 x 10–16, stood up against the last bent put in; after being raised, 4 men, by standing on the

cap, would settle them to place so we could put on the stringers and ties. (The trackmen did not have to wait for the bridge.)

No two washouts are alike and no set rules can govern. The main thing is to be prepared and get there quick. Feed your men well and sleep not until traffic is resumed.

As a general thing I have been able to use the pile driver; at times have had to set hammers on tip of pile and drop both together, and then chain pile to leads of driver to prevent its raising before we could hit it again, but as a rule have been able to cross all trouble with the driver (for which the men and not the supervisor deserve most of the credit).

For rebuilding I have never used anything but pile bents for falsework.

F. E. Schall, Bridge Engineer, Lehigh Valley R. R. There are no doubt many methods which can be adopted, depending, of course, on the conditions each case presents, such as depth of water, swiftness of currents, condition of bottom, grade of bottom, etc.; each case would practically demand a different procedure or method.

Answering your questions, as enumerated in your letter, I submit the following:

Frame a bent with two or four posts, length of posts to suit shape of bottom of stream; place cross bracing on one side of the bent, scab each post to cap, then spike railroad irons to the foot of the posts; fasten guy lines to bents and place bents in position with a derrick car of sufficient capacity and reach; after bent is landed fasten temporary plank to bent to hold it in position, then place as many more posts under cap as are required to give proper bearing on stream bottom, then place diagonal plank on the other side of the bent and deposit stone around foot of bent to keep it in place and protect it from washing away. For rebuilding trestles or for new trestles the bents should be provided with sills, each bent four posts, two vertical and two batter posts, except for very skew structures, where additional posts may be required.

New Trestles. The foundation for bents, where water is not too deep, should be of concrete walls of sufficient height and thickness to give a good bearing for the bents; in case walls are used the bents should be anchored to them. In case the water is too deep for construction of foundation walls, the bearings of bent should be prepared under water by the help of divers, either blocking up the bents with flat stone or wooden blocks spiked to sill; after the bearings are properly blocked out and a solid footing obtained, riprap stone should be piled around each bent, and, where possible, long bolts should be driven through sills into the creek bed as an additional safeguard against washing away of bents. The foot of bents should be weighted down by railroad irons being spiked to sill and foot of posts, and the bent landed with derrick car as for No. 1.

Replacing Trestles. For this class of work the bents can be framed ready for erection on shore, and then, on account of old structure and traffic, be assembled under the old structure and then raised in position, placed beside the old bent and gradually moved into proper location; a good plan will also be to place the new bents between existing ones, fasten them temporarily to old structure, and replace floor after the bents are in place; for structures with permanent foundation walls for bents, the bents must, of course, be placed in the same position as the old ones. The bents should be weighted by spiking railroad irons to sill and foot of posts.

The conditions under which this class of work has to be done are so varied and complex that no fixed methods can be laid down for doing the work; each case will have to be treated by its own conditions and requirements.

W. E. Smith, District Carpenter, C. M. & St. P. Ry. Where water is shallow and grade not too high, I have placed common framed bents by lifting them bodily with pile driver and setting them into place, adding old rails or stone, where necessary, to help sink them, and placing blocking under sill, before or after sinking, to level them up. By careful sounding, thickness of blocks required can usually be determined and the blocks fastened to sill before sinking. If not, blocks have to be sunk and put under sill by men working in and under water.

When water is deep and swift very heavy weighting is required, and at least two guy lines reaching up stream from the foot of bent to hold bent in proper location until it is placed. Where bottom is rough, especially when water is deep and swift, I have made better time by proceeding as when driving pile bridge, except that each pile or post is struck only enough to make sure that it has reached solid bottom and is not standing on loose stones; it is then stayed until the bent is capped, braced and loaded enough to keep it in place. It is seldom that a rocky bottom is so smooth that this kind of a bridge will not stand well. The piles should not be made too sharp where there is little or no penetration.

C. P. Austin, Supt. B. and B., Western Div., B. & M. R. R. First. I think the usual way of making horses is the best; with cap sill, posts and braces, although it would depend on the washout. I think we would be governed by circumstances more than any general plan.

Second. By steam derrick if you have one; if not a shear pole is the next best.

Third. This is rather a hard question to answer. Different situations would, in my opinion, require different modes of building horses or bents.

Fourth. I would answer the same as No. 3. In 1902 I had two bridges to put on, one was to take the place of an old one for which I erected 5 bents of framed horses 14 feet high with

wood stringers to use while putting on the iron girders. The other one I drove piles for falsework as it was where there never was a bridge. This was through a fill about 30 feet deep. As I said before no general plan can be used, as situations vary so and you have to govern yourself accordingly.

E. N. Frizzell, Iron Bridge Foreman, B. & M. R. R. 1. A description of horse or bent which is advisable in case of a washout.

It seems difficult to give a rule that will fit all cases of this kind, as the conditions vary so much.

Beginning at the shore end, make bents in the following manner to vary in height according to the depth of the washout and distanced one for every 12 or 15 feet, according to the length and size of timbers to be used as track stringers. If a muddy bottom, which usually happens near the shore, a sill should be used of as wide timber as convenient to get, the ground to be leveled, and if convenient use old ties or pieces of broken timber placed in the mud where the sills should rest, thus forming the base of the bent or horse. A timber about 12 in. x 12 in., or pile of equal size, with one end about square to rest on the sill, should be erected under each rail. Another timber of about the same size, with one end cut to a bevel of about 3 inches per foot, to rest on the hill outside of each plumb timber at such a distance as with the top resting against the plumb timber will produce a batter of about 3 inches per foot, the foot of each timber or pile to be well spiked to the sill. A plank about 3 in. x 8 in. placed level as much below the base of rail as the ties, stringers, and cap timbers to be used will produce in thickness. Spike the plank to each upright timber and saw them off at the top of the plank. Place the cap timber and dowel with iron ¾ inch or 1 inch diameter and about 18 inches long. Place a brace plank about 3 in. x 10 in. on each side of the horse, one end at the top of batter timber and the other against the sill at the opposite batter timber and spike well at each point of bearing upon all timbers.

If a hard, rocky, and uneven bottom is found, omit the sill, using a plank about 3 in. x 10 in. on the side of upright timbers near the base, spiking well to each. If in a rapid current, which usually has a rocky bottom, build horses after the same manner, using ropes to locate the foot of timbers, trying two or three times for the best footing.

2. Best method of placing horses or bents in position in case of a washout.

If bents of not more than 25 feet in height are required and a light kind of timber is to be used, I think it best to put all bents in position, each piece belonging to the bent separately, using hand ropes and spike poles, each part to be held in position with light brace planks and spikes until the whole bent is together and braced for use. If the horse timbers are delivered at grade of track they should be erected from the top. This

rule has been applied with good results in a case where a bent of 40 feet was required and spruce timbers were used.

If bents of more than 25 feet are required and heavy timbers are to be used, I recommend the following plan:

Take a stick of timber, say 10 in. x 10 in. x 30 ft. long, make a mortise near one end to receive a pulley or sheave that will work a 1¼-inch diameter rope. Fasten the sheave with a good bolt or pin and use this end of the timber ahead in the direction the work is to be built. Place this stick of timber just outside the rail with the sheave as much ahead of the abutment or last bent built as it is planned to space the bents. Fasten the rear end of the timber well with a chain and wedges or a screw clamp. Place a good rope through the sheave and drop one end below for the hoist, the other end of the rope to follow the line of the track to the rear and attached to a hoisting engine if one can be secured. A winch or hoisting gear will do the work well or a locomotive may be used to pull the rope. Two timbers arranged in this manner, one at each rail, will about double the speed of the work if men are plenty to work both at the same time. After erecting the two main timbers of the horse the hoisting timbers are to be moved a little out from center line and the batter timbers of the same horse erected in a like manner. The tops of the upright timbers to be cut off at the proper height, the cap timber to be placed and fastened. When the horse is properly braced, the two hoisting timbers or poles should be carried ahead as much as is necessary to erect the next bent, the poles resting on the last bent built and so on for each succeeding bent. When very heavy upright timbers are being used, a single sheave pulley block should be used by passing the hoisting end of the rope through it and fastening the end of rope at the head end of the hoisting pole, the tackle block to be lowered to the ground for timber, thus producing a traveling sheave. It is often advisable to leave the capping of bents to a separate gang. In that case the hoisting poles may be rested and moved ahead on a girder plank placed level about 2 or 3 feet below the capping and spiked well to each set of horse timbers erected. This girder makes a good rest for staging planks.

When the current is too rapid for the pile or upright timber by its own weight to keep the position in which it is set, it may be held by ropes until enough stones have been filled in and around it to prevent it from moving with the current. If a pile cannot be readily prevented from moving in the above manner, a bent may be built on or near the shore to fit as near as possible the place for which it is intended, with a good sill to which all upright timbers are to be well fastened. Float the bent to its intended position, holding against the current with strong ropes. Weight the foot of the bent with rails or track steel, enough to sink it to bottom. Raise the bent into position and fill stones on the sill and around the base, enough to make it safe to take

off ropes and rails. This is rather a slow method, but it is good in a rapid current and rather uneven bottom.

3. A description of a horse or bent advisable for rebuilding or erecting a truss bridge.

If a deck bridge and a case of carrying trains, and not too high so as to make it too expensive for the upright timbers, I will recommend the following plan :

Take 6 sticks 12 in. x 12 in. or piles of equal strength for each bent, all to stand on a sill with good hard bottom, 4 of them to be placed in bent upright, 2 of them under the track stringers and 2 just outside old trusses to be removed or new trusses to be erected, the last 2 to be placed outside of all at a batter of 3 inches per foot, the top ends to be placed close to the top of the 2 outside plumb timbers, the bent to be girder capped with 6 in. x 12 in. and well bolted; two girder timbers about 4 in. x 12 in. placed level, one on each side of the bent, about 18 inches below the bottom chord of truss to be removed or new truss to be erected, these girders to be well bolted to the 6 upright horse timbers. These girders form a rest for light stringers for the putting together of the bottom chord, also for the staging planks. These bents must be placed so as to clear all panel points of the trusses, also to clear all truss braces or suspension bars. If a deep truss is to be handled and the bottom chord high from the ground, a pair of sway braces should be placed on the bent above and below the center girders.

If the bridge is of considerable height from the river bed, a horse of sufficient height to reach within about two feet of the bottom chord may be made after the foregoing plan, omitting the center girders, then a top horse to reach the track stringers, to be built of a 12 in. x 12 in. sill and 4 plumb timbers 12 in. x 12 in., girder capped with 6 in. x 12 in., well bolted. The sway bracing sufficient will be one piece of 3 in. x 12 in. on each side, bolted to each upright timber and the sill. If no trains to carry, bents can be made of lighter timber.

4. For erecting or putting such horses in position in a rough place where there is no structure for raising.

Make two hoisting poles of spruce or light timber 30 feet long, 8 in. x 8 in, at one end and 6 in. x 6 in. at the other. Place a pulley for a 1¼-inch rope in a mortise one foot from the small end. Truss each pole on top side with a wire rope about 1 inch diameter, using a strut about 3 feet in height at the center of each pole. Fasten the wire rope well at each end of pole. Use the poles in a horizontal position in line of track on top of bents, the center of the pole to rest on abutment or last bent in position, and the large end of poles to be chained or clamped to the bents in position, as the work advances; 2 good winches to hoist each part of the horse separately; a rope running from each winch in line of the poles through the sheave at head end and the end of rope dropped below. After the plumb and batter timbers are in position, raise one pole about a foot at the center

bearing and swing head end to center of bent being put in position; hoist, place and fasten the cap, then the hoisting poles to be moved ahead for the next bent. This kind of a pole will raise a timber 12 in. x 12 in. x 50 ft. long with safety.

R. H. Reid, L. S. & M. S. Ry.:

I have never had any experience with washouts where piles could not be driven, but had a case of bridge renewal where piles could not be used notwithstanding the fact that rock was covered with five or six feet of mud and more or less loose earth.

This was the famous "Ashtabula Bridge," which in the winter of 1876 gave the road considerable free advertising.

The old structure (a double track Pratt truss) was taken out, replaced by a heavier bridge and all traffic maintained at the same time. It was not advisable to excavate to rock bottom as stream emptied into Lake Erie and bed was approximately on lake level. A separate floor of ties for each bent was laid on bed of stream. Ties were placed close so as to minimize danger of scour as the bridge was over a rather lively stream during high water. The lower bents were framed and raised complete, but each stick of the upper bents was framed and raised separately in order to clear all the old as well as new work.

I enclose a small snap-shot photo of the falsework, taken by one of the men.

Your committee partly agrees with statements of some of the above, that no particular plan will fit all cases, but nevertheless claims that falsework constructed as described below, although it may not be the best in every case, will be found practicable in all locations. Suggestions are grouped as outlined in circular.

1. Get approximately the height of horse at both up and down stream ends by sounding and construct bent on shore as shown on sketch A. This should be made of squared timber if available, although round timber will answer. As horse is pivoted at 4 points, its shape may be changed considerably. The upper ends of sway braces and the tops of the two interior posts are to be held temporarily in position shown, by lashing.

2. Swing into place with pile driver or derrick car if on hand, otherwise by shear pole. If current is very strong, load rails or scrap iron on brace c-d. Guy bent on each side of stream, both above and below the bridge site, and when horse has been lowered to rest on river bottom, tap the top of each post with pile driver hammer if available, otherwise a heavy weight, handled by any convenient rigging will answer, making sure that posts are all down to a solid bottom. Posts are then sawed off to proper grade, cap placed, braces a-b taken off, and sway braces spiked securely.

For an illustration we show in sketch A a horse with three legs resting on small boulders with only one leg on the solid bottom. Sketch B shows position of same horse with legs all

driven down to solid ledge. Note that the two inside posts are not bolted or spiked to any of the braces and may be plumbed and then driven after the two outside posts have been forced down to a solid bottom.

Sketch C shows same horse all finished with track in place. Space bents as far apart as strength of stringers and length of same will permit. Place two stringers under each rail arranged as shown on Sketch D and drift-bolt securely.

Use sawed bridge ties if available, otherwise ordinary track ties, spaced 18 inches on centers. Spike each end of every tie to stringers.

A double track bent may be made in a manner similar to above described by increasing the length of braces and inserting four or more interior posts instead of two, as shown, but it would seem advisable in case of a washout to get trains over an opening on a single track trestle and then go back and take care of the other track.

If your timbers are not sufficiently long for posts, one or more decks may be constructed in the usual manner on top of horses built and placed as described.

3. Horses designed as shown in Sketch A will apply to rebuilding trestles permanently or may be used for falsework in erecting new structures, as well as in case of a washout. Of course, in the first two mentioned cases, soundings may be taken more accurately and an allowance made in the length of posts for the profile of river bed so as to have bent fit track better than in the hurry and "anything to get there" of washout construction.

In places where falsework is desired to carry trusses which are to be removed, also new trusses and traveler for erection, modification of our design may be made to fit each case, preserving, however, the adjustable feature.

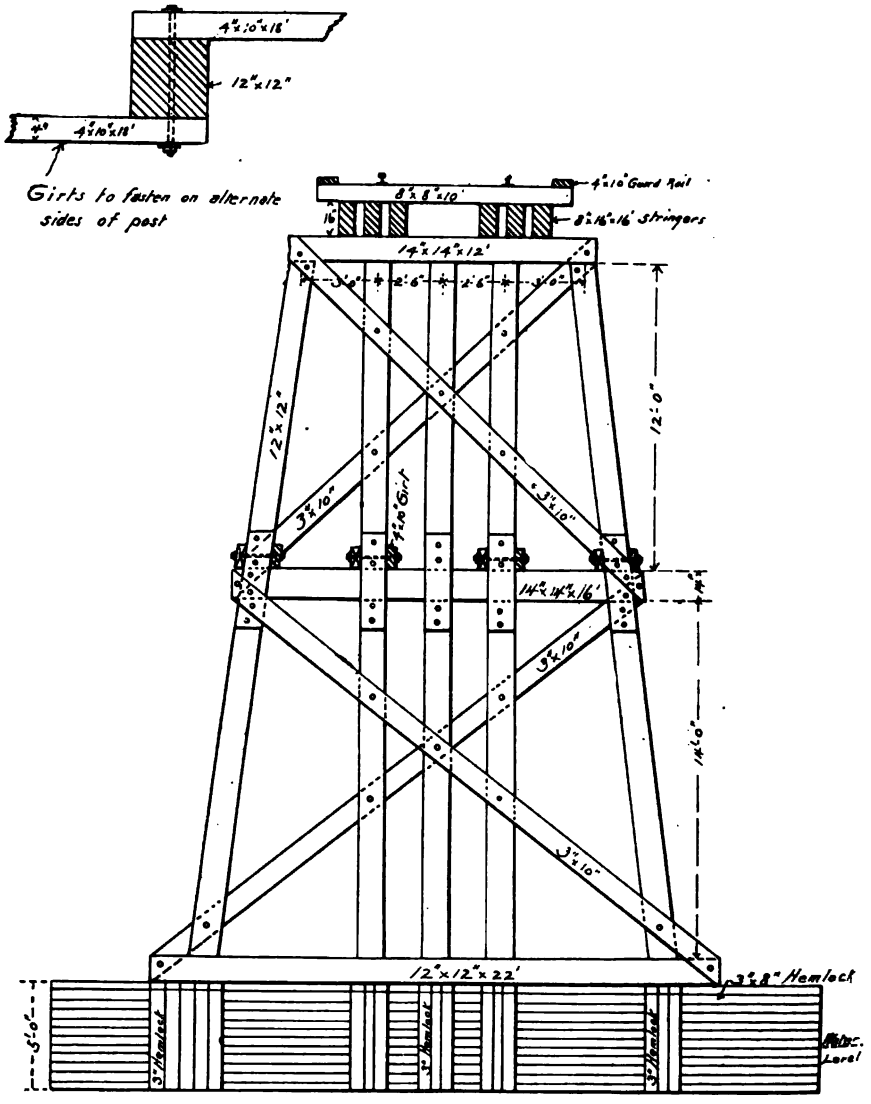
4. It is probably advisable in cases where structures are being rebuilt, which span an opening where there is sufficient water to float horses to position, to erect bents by rigging attached to existing bridge, but nevertheless, we would advise having car pile driver or derrick car on hand when such work is going on.

The idea of the adjustable horse was suggested by Mr. A. W. Savage, foreman carpenter, Fitchburg Division, B. & M. R. R.

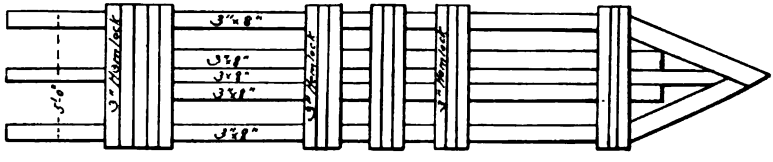
Respectfully,

J. P. CANTY,
Chairman,

O. I. KILLEBREW,
E. C. MACY,
H. H. EGGLESTON,
F. F. LLOYD,
J. E. GREINER,
Committee.



ELEVATION



PLAN OF CRIBBING

FIG. 7.

Subject No.1 - Sketches Accompanying Report of Mr. M. Riney - Chicago & Northwestern Ry.

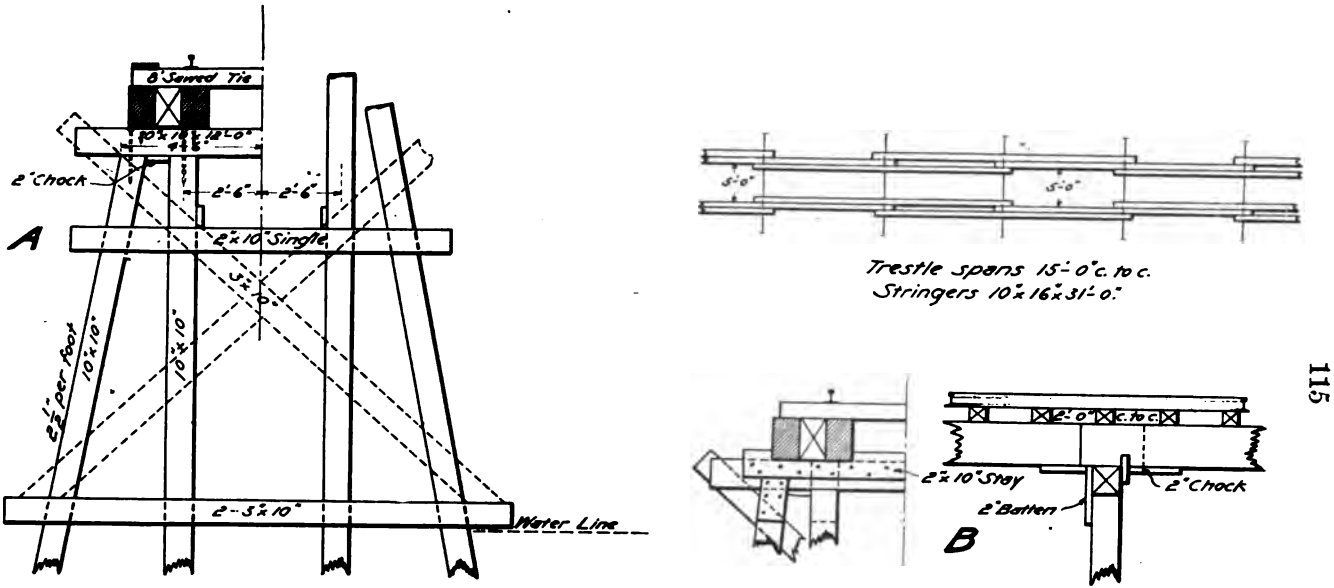
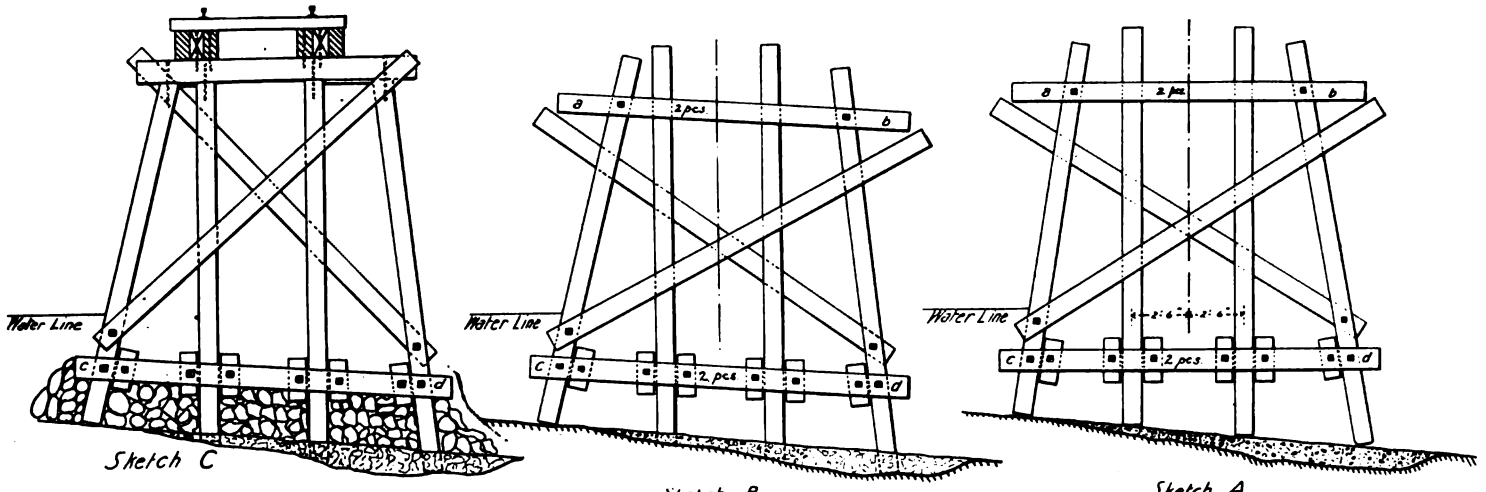
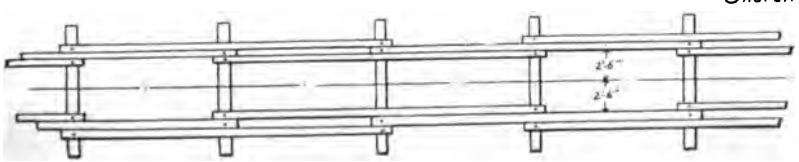


FIG. 8.

Subject No. 1 - Sketches Accompanying Report of Mr. J.P. Snow - Boston & Maine R R





Sketch D

Subject No. 1 - Sketches Accompanying Committee's Report.

FIG. 9.

FIG. 10.
R. H. Reid, L. S. & M. S. R'y, Cleveland. False Work at Ashtabula Bridge.

Subject No. 1.

(Supplement to Report.)

The following from F. S. Edinger of the Southern Pacific Railway arrived too late to be incorporated in the committee report, and, as it describes several interesting features of falsework construction, it was thought advisable to present it in the form of a supplement to the regular report.

J. P. Canty,
Chairman.

I do not know that there is anything out of the ordinary involved in the methods described, but I do know that they proved safe and satisfactory, as well as comparatively inexpensive, where purely temporary work was required.

Plate No. 1 represents the manner in which the falsework was placed under a number of old iron bridges which were to be taken down and replaced with heavier steel spans. The stream was very rapid, and in most cases the rock bed was comparatively free from gravel, though large, irregular masses of volcanic rock were plentifully strewn over it. The height from the rail base to bed of stream ranged from 25 to 50 feet.

Usually one bent could be set up on each bank of the stream by ordinary means, generally with the posts resting directly on the rock in preference to sills and blocking—being less likely to be disturbed in case of a rise in the stream. For the bents which stood in the water the method of procedure was as represented by plate No. 1. A timber "A" 12 inches square, and of suitable length, was first bored to receive bolts from girts "B" and "C," the holes being 8 or 10 inches apart, and covering the probable range in position of girts due to irregularity of bottom. The timber "A" was then lowered outside of the up-stream truss directly opposite the proposed position of the bent, with the lower end resting on the bottom several feet further up stream than the posts of the bent were likely to be set. Usually some natural obstruction on the bottom would prevent it from being displaced by the force of the current after being set, but frequently it was necessary to secure it in position by means of ropes attached to the timber "A" just above the water surface, and fastened to suitable objects on the bank of the stream. The top was securely lashed to either a post or the bottom chord of the truss, as might be most convenient, this timber serving as a temporary anchor for the bent.

The girts "B" and "C" were then lowered to place, and the up-stream ends bolted to the timber "A." The down-stream ends were suspended by means of ropes "D" and "E," of sufficient strength to support the girts, staging planks "H," and several men with safety.

The planks "H" were then run out over the girts, and some of them fastened at both ends, temporarily, to prevent swing-

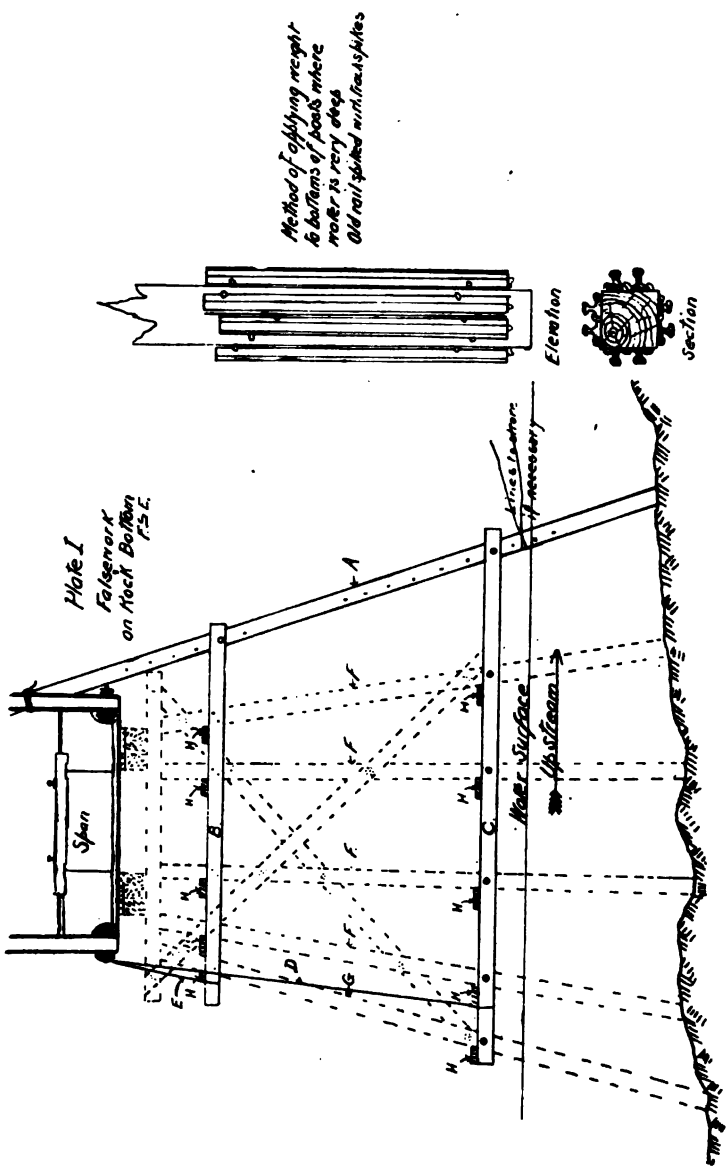


FIG. 11. Subject No 1 Sketch Accompanying Report of Mr F. S. Edinger Southern Pacific Ry.

ing of the girts "B" and "C." The posts "F" were then lowered to the bottom in the angle formed by "H" and "C"—"H" being temporarily out of proper position, two or three feet up stream. "H" was then allowed to move down stream along the girt "C," impelled by the force of the current acting against the foot of the post until a natural obstruction or depression in the rock bottom stopped the foot of the post "F" at some point as near its proper position as could be obtained with secure footing. Posts "F" as fast as set in place were secured to girts "B" and "C." Tops of posts "F" were cut off, and cap-sway braces and longitudinal girts put on, after which timber "A" was removed and used in placing the next bent.

Where, in the judgment of the foreman, there was any uncertainty as to the bearing of the posts on the bottom being good, or the stability of a four-post bent being insufficient from any other cause, additional posts were put in, as indicated by "G."

Where current was too rapid or water too deep for the posts to reach the bottom readily on account of their buoyancy, the bottoms of the posts were weighted with scrap-rail spiked to the posts with track spikes as shown in plate No. 1—as many rails being attached as were necessary. It is needless to say that these structures were unsightly, as alignment and symmetry were alike sacrificed to secure proper bearing for the posts on the rock bottom, which was seldom found exactly where it was desired to place the foot of the post. However, plenty of girts and sway braces were used to prevent deflection of the posts due to unavoidable inclination of same. Settlement of the bents as a whole or of individual posts was not sufficient to cause any uneasiness.

Plate No. 2 represents the method used in the construction of a temporary trestle crossing a lake formed by a landslide damming the stream lower down. The bed of the lake was solid rock, and it was impossible to drive piles. The depth of the water and nearness of grade to surface of the water made it a difficult matter to brace the bents laterally. This was overcome by using short, lateral girts connecting two adjoining posts only. Rods, having eye-bolts attached to one end and long thread and nut on the other end, were used for transverse bracing. Soundings were first made to determine as accurately as possible the length of each post. The bents were then put together on the edge of the lake with the various lengths of posts, as determined by the soundings, in their prospective positions, and the girts so placed as to be horizontal, assuming that the posts were of the proper lengths, the caps being left off. The rods were secured to the outside posts permanently by means of the eye-bolts at the bottom, and temporarily by lashing their top ends to the tops of the posts where they could be reached after the bent was in position.

The lower ends of the posts were then weighted so that they would readily sink to the bottom. The bents were then floated

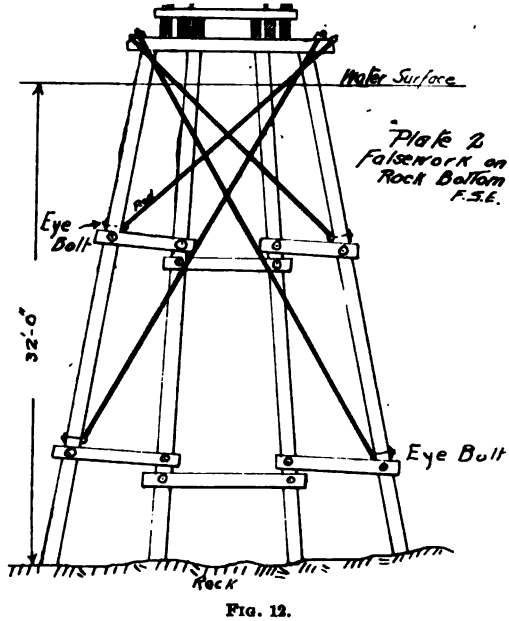


FIG. 12.

Subject No. 1 - Sketch Accompanying Report of Mr F.S. Edinger Southern Pac Ry

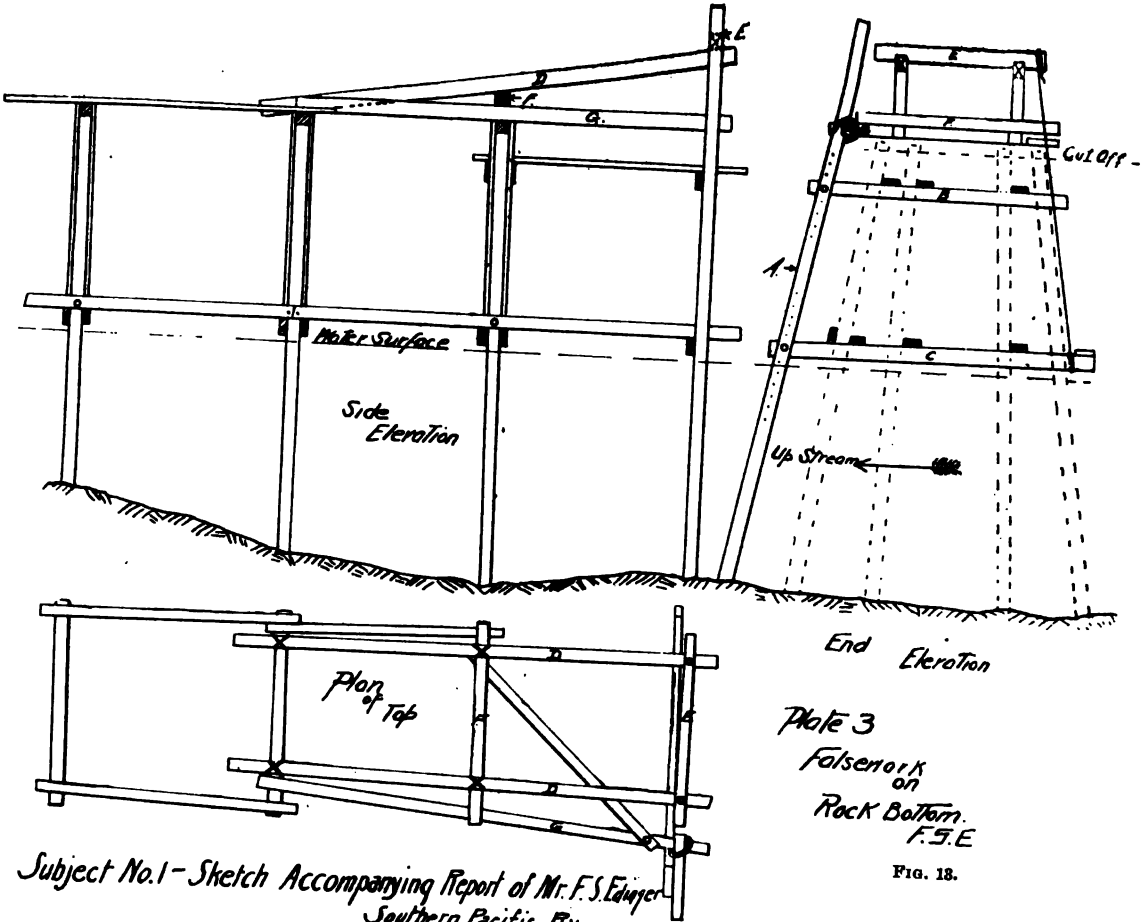
out to place by means of a pontoon pile driver, stood up in position and guyed with ropes to hold them in place. The posts were settled to the bottom by tapping lightly with pile-driver hammer—the articulated girts allowing each post to rest on the bottom independently of the other posts in the bent, and were then cut off and capped, after which the sway rods were fastened to the cap by cutting into the side of the cap to allow them to lay flush with same, and bolting a 4-inch plank to the side of the cap over the rods, putting on washers and nuts and cutting off the surplus rod, if it was in the way after adjustment.

Several 80-foot wooden spans were put into this temporary structure on piers built on the same general principal as the above described bents, the girts being articulated both transversely and longitudinally to allow each post to rest on the bottom independently of the others. These piers were loaded down by laying steel rails across the girts. The structure was remarkably rigid, and answered the purpose very satisfactorily until such time as the stream had cut through the landslide, and the subsidence of the water made it possible to put in a permanent structure.

Plate No. 3 represents the placing of falsework on rock bottom by means of overhanging timbers, "D" and "G," and an anchor timber, "A." The operation is much the same as that represented on plate No. 1, except that the timber is lowered to place by means of a turn with a rope around the stick "E" or the end of "D," or other suitable tackle, or "D" may be one piece of timber lashed to the center of the cap at its lower end, and free to move on the blocking "F" so that its upper end can be swung directly over any particular post. After the bent is in position the overhanging timbers and anchor post are moved ahead for the next bent.

Occasionally it has been found necessary to sink an open grillage of green poles or other flexible material around some of the bents and fill same with rock to prevent the bents sliding out of place where the rock bottom was smooth and the current swift. In some cases, a complete lateral system of bracing has been put in on the lower system of girts to prevent individual bents from moving at the foot. Wire cables stretched to suitable objects on the up-stream shore have also been used to prevent falsework from being carried down stream, where it was considered advisable. The conditions under which the work is done are so variable that the ingenuity of those in charge is frequently taxed to the utmost to secure satisfactory results. Perseverance, however, will usually surmount difficulties which seem at times impossible to overcome, especially where reënforced with the conviction that failure is not expected and will probably not be countenanced.

(Signed) F. S. Edinger.
J. P. Canty,
Chairman.



Subject No. 1 – Sketch Accompanying Report of Mr. F. S. Edwyer
Southern Pacific Ry.

Plate 3
Falsework on Rock Bottom.
F. S. E

Fig. 13.

DISCUSSION.

Mr. Lichty.—I do not know whether this discussion is limited to the subject proper, or whether we can branch out on outside matters pertaining to the same subject. We have at one of the water powers on the Northern Wisconsin Division, a tail race which is nine feet deep, blasted out of solid rock. When this race was blasted out, shallow pockets were blasted in the bottom of the channel, in which were set piles, and these piles form part of the trestle, which is 18 feet high,—9 feet in the water and 9 feet out. The spans as built were 19½ feet in length. We are now about to rebuild that trestle; the water is quite rapid and we wish to reduce the span lengths to 13 or 16 feet, and to get a bent set up in that channel without weighting down the bents as we do in some cases with rock or iron. It will be quite a problem, and I would like to hear if any of the members have had experience in work of that kind, what kind of a bent they would build, and how they would erect it, keeping in mind that the bottom of the present channel is somewhat uneven, and that the water cannot be taken out of the race now, as it was when originally blasted out, but has to be kept going.

Mr. Montzheimer.—I do not think this is a matter that pertains to the subject. The subject refers to false work and not permanent work. However, it seems to me a good form of construction would be to put in caissons filled with concrete supporting I-beams of about 24 feet in length.

Mr. A. S. Markley.—Why not put a span up with an abutment on both sides?

Mr. Lichty.—I would like to say in regard to Mr. Markley's plan of a bridge that no doubt this would be an easy way to do it, if the company will do it that way.

Mr. A. S. Markley.—Through the flat prairie country of the Middle West dredges quite frequently are obliged to pass through the railroads where pile trestles and other bridges are maintained. In case of the former our former custom was to pull the piles with heavy wrecking derrick which has a capacity of thirty-five to sixty tons. Owing

to the uncertainty of this method of being able to pull the piles and from an economical standpoint, we have adopted the plan, where at all practicable to do so, to build coffer-dam around the bents sufficiently large for men to work in, to cut off the piles low enough and level to admit of dredge passing over them. As a rule with us, dredging is done in small streams where but one or two bents only are required to be removed in this manner and where there is but small amount of water, and depth does not exceed four to six feet. After the dredge has passed through, framed bents previously prepared are set on the piles, cut off, and left there until bridge is again renewed. This practice can also be followed where bents are to be placed in streams with irregular rock bottom, anchoring them by boring hole through the sills, drilling in the rock, and surface up the large crevices under the sills with concrete if so desired.

Mr. Lichty.—I would like to ask Mr. Markley how he would do all that at any reasonable expense, on an uneven bottom.

Mr. A. S. Markley.—You have got to spend money. Cannot do it without.

Mr. Steffen.—I might suggest that the caisson could be made of such construction that it could be floated from its position where used temporarily and moved from pier site to pier site as you go along, that is, float it to the spot desired and sink it, and then when you are through using it there, pick it up again and float it over to the next place.

Mr. Large.—If the trestle is on solid rock and Mr. Lichty merely wants to reduce the length of the spans, it strikes me the way to do that would be to do away with a sill entirely, use an iron pin and drill a hole in the rock and drop the pin into it for fastening the bottom of the post to the rock, and then put on good bracing as low down as the case would permit. Simply a bent without a sill. That would be my idea of undertaking it.

Mr. McIntyre.—Mr. Large has hit it.

Mr. Steffen.—Of course it would be necessary to provide some means of drilling those holes under the water that Mr.

Large speaks of. That is assumed to begin with, whether by coffer-dam of by a diver, directing the drilling operations.

Mr. Lichty.—In Mr. Large's suggestion, there was nothing mentioned for holding the work there until completed, or until the deck is put on the bridge. Simply setting up a few bents and bracing them on solid rock in a rapid current is not a very easy matter.

Mr. Canty.—I think there is a description in the report which covers this, written by Mr. Edinger, of the Southern Pacific, and if Mr. Lichty would read it he would find a solution. Several other reports cover same point satisfactorily.

Mr. Lichty.—I would just like to ask Mr. Canty if most of those problems do not permit of weighting the bents down at the bottom. We are not permitted by the management of the water power to put any obstruction in there to weight it down.

Mr. Canty.—In answer to Mr. Lichty I would say that the rails are fastened vertically on the posts.

President.—So far the discussion has been taking the line of permanent work, but the title of the subject would seem to indicate that it was for false work in case of washed out bridges or in case of emergency trouble, perhaps someone would like to talk on false work more particularly.

Mr. Powers.—I think Mr. Riney gives a pretty good description for doing that class of work that would overcome any difficulties in fast-running streams. I had a little experience with that same style of work myself.

Mr. Canty.—By reading the report you may find two ways mentioned by the members for doing this kind of work. One is to put up each post separately, the other describes methods for assembling each bent on shore. Good reasons are given for both ways. The location would indicate which method should be used.

Mr. Large.—I never had a great amount of experience in very rapid streams, but I have had to get a track across quite rapid streams in rather deep water and always found the easiest way to do it was with a pile driver, and just build the road as I went along.

Mr. A. S. Markley.—I cannot see where there is any advantage

to be gained in setting a single post at a time and sawing them off and putting on cap after doing so. It is possible for the bottom to be so irregular that this is necessary. In pursuing this method it requires the anchoring of each post, top and bottom, independently of each other, consuming very valuable time. When circumstances require this kind of work it is a time when road is blocked from washout and time is more valuable than money. Where it is at all possible to do so bents should be assembled on shore where they do not exceed thirty or forty feet high and set in by use of pile driver or derrick car much cheaper and quicker than by single post at a time.

Mr. Lichty.—I would like to ask Mr. Markley when he frames his bent out on the shore and takes it in and sets it up in place, how he arranges that?

Mr. A. S. Markley.—I use the pile driver or derrick to place them.

Mr. Canty.—The committee report shows plan for a bent to be framed on shore and afterwards placed in position by means of a pile driver or derrick. It is made in adjustable form, being bolted at the four corners. The sway braces are bolted to the posts down low near the bottom but are to be temporarily lashed at the top until after bent is adjusted to the bottom of the stream.

Mr. Burpee.—I would like for Mr. Alexander to tell us about driving piles into what was supposed to be rock bottom.

Mr. Alexander.—I have been very much interested in the discussion on this subject, though I have not very much to add myself. I have learned some things in regard to this false-work business, but as a matter of course you cannot determine on any one particular plan that would be applicable to all cases. That is something we cannot decide very well. In regard to what Mr. Burpee said about driving piles in rock bottom, we have done that by using a cast-pile point and succeeded in driving the piles into a shaley rock bottom; these piles having cast-iron points by which we were enabled to drive them two or three feet into the rock.

Mr. Canty.—Mr. President, personally I am in favor of

framing horses on shore, because horizontal braces may be fastened down at the bottom of the bents. Where the water is deep and each post is put in separately it is difficult to get the horizontal braces on low enough. Low bracing is quite an essential thing in my opinion for bents of this kind,

Mr. Carpenter.—There is one thing that I have often thought would be very useful and that is, I would suggest that the engineering department cross-section all openings and give us something by which we could work by quickly, something for ready reference, and by which we could tell exactly what length posts would be required for bents in case of emergency trouble, etc. I think that would be very useful information to have. I believe that it would justify the expense because it would be very valuable some time if a post should get knocked out of a viaduct sixty or eighty feet high, to know just at a glance how high it is, without having to go out and measure with a tape line, and I want to say our engineers have promised me that they would cross-section all my high viaducts, as well as my spans across streams, that I might be prepared for just such an emergency as this.

President.—I would like to ask Mr. Carpenter why he does not cross-section those bridges himself? I am a pretty good engineer with a plumb bob and level and steel tape and can do a good deal of that myself, as I do not like to infringe on the prerogatives of somebody else. Ordinarily our engineers do not hesitate to lend me a level and generally they give me a pretty good one, and not one that they cannot use.

Mr. Carpenter.—That is out of the line of the bridgemen to get those things. They are not expected to do this technical work; you might call it out of the rank or file of the bridgemen to get that. The engineers are supposed to give that information. We have several engineers and probably they would not like to hear me say that I could do it.

Mr. A. S. Markley.—With the soil we have it would be necessary to change that data on our road about every six weeks.

II.—Should Ties of Bridges be Gained so as to Leave Rail Without Camber, or Should only a Portion of Camber be Taken Out?

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

We find that nine members prefer a straight deck on bridges, taking out all camber; three take out half the camber; one member who has wooden lattice trusses, with about 2¼ inches camber in them, leaves one half the camber in; eleven leave in enough camber to bring the bridge level under a full load; three members leave all the camber in iron bridges; two take out the excessive camber in the stringers, where wooden stringers are used; one recommends taking out all camber in ordinary plate girders, but leaving the camber in in long and shallow plate girders, where the deflection is noticeable; one leaves the camber in for ordinary plate girders, on the assumption that the camber framed in these spans is so small as not to be noticeable; two prefer a straight deck over piers where there is more than one span; one leaves about one half camber where there are several spans of 150 feet or less; three members design bridges so that the excessive camber can be taken out in the floor system. This, in a general way, covers the range of information received.

The committee would recommend that in all new truss bridges enough camber should be provided to bring all joints to a full bearing when the structure is fully loaded, and take out the excessive camber in the framing of the floor system, leaving enough camber in the track so that the bridge will come down level under a full load. Under something less than a full load, the track will still have a slight crown to it, which is less objectionable than a sag would be under a maximum load. Ordinary plate girders under 60 feet long should be designed without camber. Over 60 feet long the camber should be equal to the deflection of the girder under a full load. Plate girders of special proportions should be designed for each special case, as no uniform rule would apply to all proportions of girders. Wooden truss bridges, of course, would require more camber than iron bridges, but the same rule would apply to them as to the iron truss bridges.

R. H. Reid,
Chairman,
Onward Bates,
H. D. Cleaveland,
Henry Goldmark,
J. E. Johnson,
G. W. McGehee.
Committee.

APPENDIX TO COMMITTEE REPORT NO. II.

ADDITIONAL INFORMATION BY LETTERS.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.

CHICAGO, September 7, 1903.

Mr. R. H. Reid, Bridge Engineer L. S. & M. S. Ry., Cleveland, Ohio:

DEAR SIR: The circular letter from the committee on subjec. No. 2, A. R. S. B. & B., was mislaid, and has just come to hand. I trust my reply will not be too late to be of service to the comt mittee.

It is the practice on this road to design all but short bridges with camber; the camber to be such as will leave the track about level when the bridge is loaded. Generally the ties are ganged to a uniform depth, so as to leave the same amount of camber in the track as there is in the structure, which practically makes the track level when the bridge is covered with a load. Where we have two or more spans in any one bridge they are oftentimes specially treated by reducing to its minimum the camber in each particular span and raising the ends of spans over piers, so as to approximate the camber over the entire length of the bridge, thus obviating sags which otherwise would come immediately over the piers.

Yours truly,

C. F. LOWETH,
Eng'r and Supt. B. and B., C., M. & St. P. Ry.

AMERICAN BRIDGE COMPANY OF NEW YORK.

MONADNOCK BLOCK,
CHICAGO, ILL., June 27, 1903.

Mr. R. H. Reid, care L. S. & M. S. Ry., Cleveland, Ohio:

DEAR SIR: Replying to your circular of inquiry regarding the questions "Should ties of bridges be gained so as to leave the rail without camber, or should only a portion of the camber be taken out." Since I am not at present in the employ of any railroad company, I can only state my personal opinion, which has been developed during several years of experience with the C., M. & St. P. Ry.

I think it unquestionably true that the ties of bridges should

be framed so as to take out only a portion of the camber. The amount of camber left in the rail should correspond as nearly as possible with the deflection of the bridge under the heaviest loads. The result of this will be that the heaviest locomotives passing over the bridge will pass along on a straight line instead of on the line which is cambered or sagged.

The securing of good practicable results is dependent not only upon the question of how much camber to leave in the rail, but also upon the methods followed with regard to supports under the rail across piers and abutments. There is more elasticity everywhere else on the bridge than there is immediately over the piers and abutments, and for that reason the supports at those points should be left slack or some allowance should be provided in some other way so that they will not appear to be hard spots in the track.

Yours truly,

G. W. SMITH,

Manager Erecting Department, American Bridge Co.

BOSTON & MAINE RAILROAD.

BOSTON, MASS., June 29, 1903.

Mr. R. H. Reid, L. S. & M. S. Ry., Cleveland, Ohio:

SIR: Replying to circular letter relating to subject No. 2, Am. Ry. Supts. B. and B., I beg to submit the following:

Our practice is to build but little camber in iron bridges, and where there is but one span we frame the ties parallel to the camber. Where there are two or more spans our practice is to take out part of the sag over the piers. In such bridges, with spans of 150 feet or less, we leave about ½ inch of camber in each span. Theoretically I would like to retain a camber in the rails just equal to the deflection of the bridge under the trains, but the train weights vary, and each bridge deflects according to a law of its own, so the best we can do is to work to an assumed average which looks to accomplish the above result.

The matter of camber in a bridge is of no account as far as the strength of the bridge is concerned. The attempt to prove that a train bears more heavily on a bridge which sags below the level than on one which is straight, by reason of the centrifugal force developed by the train running over the downward curve, is useless, because the curve is too flat to develop radial force worth counting. If a bridge is built exactly straight, or with a sag, it will be just as strong as though it was built with an upward camber. The only feature of importance to consider is the surface of the track. A sag or bunch is as objectionable on a bridge as on any part of the track. And anything that causes a sense of rising or dropping to a person riding on an engine should be avoided about a bridge.

The bridge floors of the Boston & Maine road have main stringers directly under the rails, with side stringers near the ends of the ties. With stringers under the rails, the only duty that the ties have to perform is to hold the track to gauge and line, and hence there is no need of greater thickness than just enough to take the spikes properly. Six and one half inches is enough for this, and on iron bridges we use timber 8 inches wide by 7 inches thick, notching it to 6½ inches at the stringers. A ½-inch notch is as good as more to hold the tie from working out of line, but as the timber generally overruns in thickness, we get rather more notch than this. Eight by eight inches is usually large enough to use over piers to take out the dip from camber, and this need run only one panel each way from the pier.

Yours truly,

J. P. SNOW,
Bridge Eng'r, B. & M. R. R.

BATES & ROGERS CONSTRUCTION CO.

1205 MANHATTAN BUILDING,
CHICAGO, May 27, 1903.

Mr. R. H. Reid, care L. S. & M. S. R. R., Cleveland, Ohio:

DEAR SIR: Replying to your circular letter asking if the ties of bridges should be gained so as to leave the rail without camber, or should have only a portion of the camber taken out, I can only quote my practice in this matter.

In building steel bridges it has been my custom to give very little camber in the steel work,—about as much as would bring the track to a level under a loaded train, and then to use ties of uniform thickness, without notching them. These ties are held in place by bolts with thick washers attached to the stringers. There are many advantages of using ties of uniform thickness without notching them. In the first place, we save the expense of notching and the ties can be surfaced by a planing machine and delivered at the bridge ready to put in place. When ties are not notched old ties can be taken out and new ones put in to much better advantage. Ties which are not notched are also stronger than those which are. I have seen ties crack in the direction of the grain of the wood, the crack beginning at the notches.

During my connection with the St. Paul road it was the regular practice to have all ties surfaced to uniform thickness, both for iron and wooden bridges. With this exception, I will answer your question by saying that such camber as is desired in the bridge should be made in the steel work, and that ties should not be gained.

Yours truly,

ONWARD BATES,
Civil Engineer.

THE OSBORN ENGINEERING CO.

OSBORN BUILDING,
CLEVELAND, OHIO, June 22, 1903.

Mr. R. H. Reid, The Lake Shore & Michigan Southern Ry. Co., Cleveland, Ohio:

DEAR SIR: On the subject of camber will say that the object of it is two fold: one purpose of it is to bring the chords of compression members perfectly square at the ends when subject to their maximum load. The other object is to give the bridge a slight upward curve to prevent the appearance of sagging, which it would have if the chords were perfectly horizontal. I think individual cases should be treated according to circumstances, as it is difficult to lay down a general rule.

In a plate girder span of ordinary length I would take the camber out of the track. In plate girders of long spans, particularly if they are proportionately shallow, some camber, at least, should be left in. In the short deep-plate girder there is not much, if any, deflection, and the track therefore would not deflect appreciably under a passing load. In a long, shallow-plate girder the deflection would be apparent, and therefore the camber should be left in so that there would be no deflection of the rail below the true grade line.

In truss spans, consideration should be given to the type of construction, as to whether it is riveted or pinned. The riveted truss will naturally not deflect as much as the pin-connected truss, and therefore should not be given as much camber.

In a single truss span I do not see why the proper camber should not be left in the track. By proper camber I mean the amount which would be taken out by the passing of the maximum load. The track may not look so well with the camber in it, but it should be borne in mind that this camber comes out as the train passes over the bridge. If the camber is taken out of the ties, then, as the load passes over the structure, the rail deflects below the natural grade, and consequently centrifugal force occurs, which naturally increases the stresses of the bridge beyond what would occur from the vertical load alone. It seems as though we are to choose between the appearance of the track to the eye and the effects of centrifugal force upon the bridge. The latter, of course, can be provided for in the calculations for new bridges, but in adjusting the track upon existing bridges, it would seem the part of wisdom to leave the camber in the track rather than to remove it.

Yours truly,
FRANK C. OSBORN.

DISCUSSION.

Mr. Canty.—On my division all the ties on bridges, when they were originally put in, were gained so that none of the camber was taken out, but I have observed that the section hands often shim up on top of the ties at ends of bridge and over piers, so as to make a higher grade line over bridge, and thus practically take out the camber, or otherwise complain loudly about the rough track. I have also found that when timber is renewed the bridge foremen will gain their ties so as to make them fit the rail, so if track has been raised at ends of bridge by section men the crowning of bridge due to the camber will not show on the track. Where this has been done we have heard of no complaints about the track riding poorly, but, on the other hand, we frequently receive reports of rough surface where the camber shows in grade of track. It being necessary to renew ties on several of our large bridges during the past year, we had engineers run a grade line over structure and had ties framed to take out all of the camber. Since this was done tracks ride much smoother than when camber showed in track. I think the results obtained from leaving some of the camber in do not amount to much. I have never made an especial study of this point, but it is my present opinion that all or nearly all the crowning in track due to camber in bridges should be framed out in ties. My idea is based wholly on observations, as stated.

Mr. Reid.—In line with the report I would say that when the roadmaster and section foreman criticise the bridge superintendent in regard to camber in his bridges, they must think that he is not "on to his job." The bridge men are supposed to be competent to decide what camber is wanted in a bridge, and I think we ought to have enough camber to offset the deflection in a structure under a maximum load, so as to have a good riding surface in the track.

Mr. Alexander.—We find it is better if the camber in a bridge is not too much, to just leave the camber in it, and do not fear any bad results at all.

Mr. Carpenter.—Some years ago I was on the Cincinnati Southern and I had under my charge the well known high

bridge across the Kentucky river. It was some three years after I had gone there or had charge of that line that one day I received telegram saying the piers of the high bridge are reported settling. I went there on the first train but could not see any signs of it, and no cause for any alarm; they had simply discovered the camber in the spans, which was about four inches in spans of 375 feet long, of the cantilever style. They were unnecessarily alarmed, and I was instructed to make a report immediately. I did so and satisfied them that there was nothing wrong, but I renewed the deck on that bridge shortly after and took the camber all out.

Mr. Lichty.—I suppose Mr. Carpenter would liked to have asked those people who had just discovered the camber in that high bridge and thought the piers were settling, how they accounted for the fact that the bridge stayed up while the piers went down.

Mr. Cunningham.—From what I have heard, I thing a number of the roads must be using very large timbers if they can take all of the camber out of their bridges in the framing of the ties. Our ties are 8 inches by 8 inches, and I do not see how we could take out all the camber on an 80-foot deck span and have enough timber left.

Mr. H. H. Eggleston.—We leave sufficient camber in our bridges so that when a full load comes on the bridge the camber is just sufficient for a good level surface. This applies to through truss spans of 160 feet, lattice riveted. On deck girders and through girders we frame out for plates and what camber is in girder or stringers we leave in, for the same reason as stated in through truss spans.

Mr. A. S. Markley.—Mr. President, I think where the camber in a bridge exceeds the deflection $\frac{1}{2}$ or $\frac{3}{4}$ of an inch the camber should be taken out in the track stringers by the manufacturers who manufacture the bridge. This also applies to the elevation on curves, so all the ties will be uniform thickness throughout the bridge, excepting, of course, where thickening plates are placed on top of the top chord it will be necessary to take out the thickness of these plates in the dap of the tie. We have considerable trouble with our through

bridges and track stringers where they rest on pedestals of stone that rest on the pier or abutment. In many cases the bearing plates wear down into the stone, which makes an irregular surface on the bridge and the expansion and contraction of the iron tearing out the anchor bolts on the expansion end. Oblong holes are provided, of course, to overcome this in the flange or bearing plate or the stringer, but this at all times does not overcome the objections. There should be an additional floor beam put in at ends of span to carry track stringers instead of resting on pedestal. This floor beam connection should set on the end pin or be carried by the span itself and not on the abutment. This is good practice and I notice some roads do it, which avoids not only the expense but a great deal of annoyance to those who maintain the structures. The wearing of the end plate under the pedestal occurs, of course, more on sand stone than on hard lime stone, but both of them wear more or less. We have in several cases substituted cast-iron bearing blocks anchored to masonry and dispensed with anchor bolts through the flange or bearing plate of the track stringer through the cast-iron bearing block; this allows the track stringer to go and come at will endways. Lug is cast on side and top of pedestal to hold stringer in line.

Mr. Carpenter.—I would state that I am very much interested in this discussion and that in regard to this matter of camber my custom is to show a straight deck on all bridge spans, either by gaining out the ties in centre of span, or increasing them on ends of spans, and in some cases I do both. I think that a sag or low place in a good track looks very bad anywhere, and I prefer not having them in any of my bridges; then again, if all or a part of the camber is left in the deck of a span, a part of this camber may go out by span settling in centre for various reasons and it would not be readily noticed, but if a span has a straight deck and part of camber should go out of span from any cause whatever, the deck would show a vertical curve below a straight line, and would be noticed quickly by any railroad man; and it would not be long until a report of it would reach me, and a minute investigation would follow at once.

Mr. Ingalls.—On the Northern Pacific we do not try to take the camber out of truss bridges. The shortest span which I have is 115 feet and the longest is 403 feet. You can readily see that on the long span it would be almost impossible to take out all of the camber. For a short pony span it might be all right to take the camber out, but on long spans I am not in favor of it.

Mr. Sheldon.—It is the custom on the N. Y., N. H. & H. R. R. to take the camber out of track on bridges by the gains in ties being cut of varying depths. I think a much better way would be to take it out in the floor beam, in which case a standard gain, and standard tie could be used. Camber I think should be taken out of track, particularly in spans of 200 feet or less. When centre of bridge is high it looks bad. When section men are surfacing track they always bring the low places up to the high points. The foreman from some distance sights the track to a surface on line with high rails in centre of bridge and when he gets to the end of bridge finds that track is high for ends of bridge; he usually puts shims on bridge ties and sends word that ends of bridge are low, and there is no ground for debate, they are low and show it.

Mr. McIntyre.—Plate girders generally have very little camber and the deflection is small. I should not take out the camber in framing the ties, which should be gained only to suit the cover plates. Pin-connected bridges usually have more camber when first erected than other bridges, the deflection is also greater. It is the custom of this road to frame the ties all alike; that is, ties are all framed to one pattern. If the camber is taken out in the ties, you put the center of bridge in a hole under a load, which is not good practice. It was the practice years ago to take out about one half of the camber in Howe Truss bridges; this was done in the stringers that lay on the floor beams; but I find our metal bridges of to-day have not one quarter of the camber we used to put in the Howe Truss bridges.

Mr. Noon.—I would say that I always take out the camber of a truss bridge by either dapping the ties or floor beams, so as to take almost all of the camber out of the rail.

Mr. Banks.—I will say that it is our practice to gain the ties so that the surface of the rail is perfect without being loaded. In addition to this being the rule, I think this is the right thing to do. My reason for this, is because a good bridge will have very little deflection under weight of train and when bridge is not loaded, the surface will be good.

Mr. Lichty.—I prefer leaving in the camber in spans of 100 feet and over, especially trusses. Short and stiff structures like girders, etc., should have very little or no camber, in my opinion.

Mr. Cunningham.—The practice on ou rroad is to dap ties on bridges to take out if possible one half the camber. The reason for this is that all bridges are designed with such an amount of camber as would require more than the maximum load for which the bridge is designed to take it out entirely, but as new bridges are always designed for about double the capacity for which they are at this time intended, it is impossible to get all the load on to take all the camber out. I think the best way to do is not to take out all the camber by dapping the ties, but try to get out about one half the camber and by that means you will have as nearly a level track as it is possible to have when a train goes over it.

Mr. Rettinghouse.—I believe enough camber should be left in track to make up for the amount of deflection caused by the load going over truss. We leave the camber $\frac{1}{4}$ inch more than the deflection caused by our heaviest locomotives, so that when truss is fully loaded track is level. We do not gain any ties at all but gain out on stringers or floor beams, this being easier and cheaper and in case ties are renewed we would have the advantage of avoiding new gaining.

Mr. Killam.—On the Intercolonial Railway we put our decks on nearly level, particularly on our new bridges. They are very heavy, our 200 and 250 feet spans have about two-inch camber, some not that much; on these the ties are put on the same size all the way through. None of our new spans will deflect over four-tenths on an inch with 460,000 pounds weight, so that there is no need of making any allowance for camber. Now, in my opinion, the proper thing to do is first to find the de-

flection of the span and then put the deck on according to the exact camber of the deflection of the span under the greatest weight of rolling load that ever passes over it. Thus, if the span, say 100 feet, deflects seven-tenths of an inch, then put the deck on seven-tenths camber, regardless of the camber of the structure, so that the bottom chords will be in a true horizontal line under the greatest strain of a rolling load.

Mr. Montzheimer.—Our practice is to take out practically all of the camber in sizing the ties. I think this makes a better looking track on the bridge and it rides just as good, if not better than when the camber is left in. On a bridge of modern construction there will not be enough deflection to take out all of the camber and for that reason I think the tie should be sized.

Mr. Reid.—In regard to framing ties to take out the camber, I would say that I make a camber curve for every one of our truss spans, take levels and find out just what the actual camber is, and then calculate the deflection and plat a camber curve on profile paper, showing what the camber is at every panel point and frame the ties accordingly.

Mr. Burpee.—Mr. President, I have listened with a great deal of interest to this discussion, and I believe it is up to this convention to say by a vote just what the camber in bridges should be. I mean for the benefit of the bridge designers and bridge builders.

President.—It has been moved by Mr. Burpee that the sense of this meeting should be taken on this subject for the benefit of the bridge designers. Did you not make such a motion, Mr. Burpee?

Mr. Burpee.—No, sir, I did not make that as a motion, as it is perhaps a little early, but I would if you think it would be all right to do so. I do not believe that we could vote intelligently on this matter in a meeting like this. The ballot is the best way and that should be done through a circular issued to the members, the result of vote to be embodied in the report of the committee. It is a slow way of getting at it but it is more thorough and probably quicker in the end.

Mr. Stannard.—I do not think it would be a wise thing to

make a motion of that kind, as it will be fully covered in our printed proceedings.

Mr. Sheldon.—Mr. President, as I understand the idea of Mr. Burpee was only to leave such camber in the bridge or in the rail as would bring it to a straight surface under a maximum load, and I think this is the recommendation in Mr. Reid's report, and that when we took the vote of the meeting to accept the report, that we settled that question.

President.—We practically agreed to this when the report was accepted by this body. Is there anything more on this subject? If not, we will pass it.

Mr. Markley.—It would not make any difference, the action of the convention is not binding on the members.

President.—I think perhaps Mr. Burpee's idea was to get the sense of this convention for the benefit of the designers of our bridges, and I think the idea is a good one so far as we can carry it out; and while it is partially, or largely, embodied in this report, it might perhaps be possible, if you thought it wise to take that action, to continue this committee for another year, and to request its chairman to take a ballot of the members of this Association after they receive the published proceedings and read this discussion, as to whether we shall adopt that as the sense of the Association, that the camber should be largely framed out in the floor system of the bridges.

Mr. Stannard.—If we are going to leave the camber in iron and other spans, why not leave it in trestle-work? In my judgment there should not be any camber left in any bridge that can be taken out. The nearer a perfect surface we get on our bridges the better their appearance, and they ride so much better. In iron bridges the camber should be taken out in framing the ties and in wooden spans in the stringers.

Mr. Edinger.—I would like to say that I agree with Mr. Stannard; I do not know of any case where the deflection in trestle is not greater in proportion to the length of the span than in a truss bridge. We frame out all camber in our bridges.

Mr. Vandergrift.—I have been sitting here a long time listening to the different arguments against this camber busi-

ness, and I have come to the conclusion that it is something like an incident that occurred during the late war. One day a company of soldiers were coming into camp and the command was given to support arms. One big sunburned fellow had his musket turned round wrong side front and was reprimanded by the officer, Mr. Bailey, who told him that when the order was given to support arms, to always keep his musket right side front, and he replied, "It don't make a bit of difference which side is front," and that is what I think about this camber business in bridges.

III.—In Case One Arm of an Important Metal Drawbridge Over a Deep Stream Should be Wrecked, What is the Most Expeditious Way to Restore Railway and Water Traffic?

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings.

Referring to the above subject, this is a problem in which each particular case would require special study, depending upon the frequency of the traffic, nature of the stream, whether navigable or not and the quickness or facility with which materials of suitable kinds could be had; but the following suggestions may be of use in enabling the engineer in charge of such work to decide, without further investigation, as to the particular method of restoring traffic that could be used to the best advantage for the case in hand.

The calculations below are based upon a through swing span having:

Total length of 270 feet, center to center of end bearings.

A clear opening of 115 feet between pivot and rest piers.

Weight of one arm of swing span 150,000 pounds.

Center of gravity of one arm is supposed to be one half the distance between the center of the rest pier and the center of the pivot pier.

First Method:

It is here assumed that the arm left intact covers a navigable channel or that this arm can be reversed so as to cover the other channel in case the other only is navigable.

After removing, if necessary, the debris caused by the wreck, drive trestle bents over the opening it is desired to close, support the outer end of the intact arm on a pontoon, drive cluster of piles on up or down stream side of the opening, a little back of the pivot pier; connect a steam winch located on the pontoon to the cluster by means of a wire rope which is to be used for opening the draw and to be carried back by a row boat and attached to the rest pier for closing the draw, or a trailing rope, also attached to the winch, could be used with sufficient slack to allow crafts to pass over it, and the bridge hauled back by this means. (See sketch No. 1.) A small apron raised by hand would have to be placed on the opposite side to break the track and allow the draw to turn, as shown in sketch No. 2.

The objections to this method are:

Where there is a change of tide or height of water, the pontoon would have to be disconnected from the drawbridge with hydraulic or screw jacks after each opening and reconnected for opening again to prevent the buoyancy of the pontoon lifting

the free end of the span, or better provision made for this adjustment by admitting water into the pontoon for lowering, and pumping water out for raising. Very slow method, only applicable to a bridge infrequently operated.

For a bridge of the above dimensions, the pontoon should have about 1,200 cubic feet displacement; say twenty feet wide by thirty feet long, by two feet draft; total depth about four feet. If the method of changing draft by pumping is used, the pontoon should have two or three water tight compartments to reduce lurching by wave motion, etc.

SECOND METHOD:

Drive trestle as above and counterweight draw span on wrecked side, using wooden frame for supporting counterweight and load platform with pig iron, or rails, as indicated in sketch No. 2, manipulating the drawbridge with original mechanism; this framework to be kept high enough to clear ordinary rolling stock (say eighteen feet in the clear), and using as far as possible material for tie rods or bars from wrecked arm, providing efficient vertical and sway bracing. See sketch No. 2.

Objections to this method:

Center of gravity of counterweight being necessarily close to the pivot pier necessitates the use of very great weights.

The effect of such additional weights together with the weight of the intact arm may cause a crushing of the rollers or roller tracks of the pivot pier.

Great care must be used in handling such weights for fear of racking the wooden framework and causing this portion to collapse when the bridge is being swung which would overturn the free arm into the water.

THIRD METHOD:

Drive a pivot pier between the rest pier of the wrecked arm and the original pivot pier and put in a temporary wooden or other drawbridge, spanning a portion of the channel formerly occupied by the wrecked arm, leaving the intact arm to be used temporarily as a fixed span. This is applicable where suitable timber and castings can be had quickly or where there is stock on hand from which the temporary draw span can readily be built.

This method furnishes a quick and convenient way of rebuilding the draw, if a much less opening can be temporarily used and has the advantage that it is possible to close the channel under the intact side of the draw with falsework, remove the old draw and build a new draw up and down stream, running through the center panel with the railroad traffic until the new draw is finished and ready to swing, when the temporary wooden draw can be quickly removed and the falsework taken out so that the new draw can be used. See sketch No. 3.

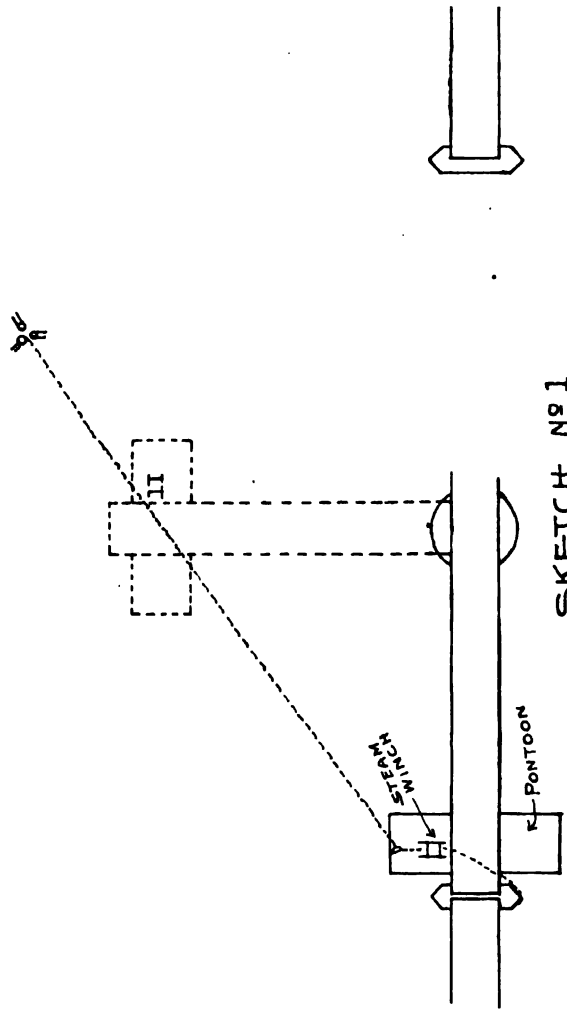


FIG. 14. Sketch, with report No. 8, by Mr. Isaacs.

FOURTH METHOD :

Replace the wrecked arm either in part or in whole with new material. This, of course, would depend upon the facility with which the material can be had.

FIFTH METHOD ;

Leave intact end of draw unchanged and use as a fixed span and carry track over channel formerly spanned by the wrecked arm on pontoons, sufficiently close together to furnish necessary support to the rails, ties, and stringers. This can be made perfectly safe by using pontoons of sufficient size, bracing them strongly together and guying them to temporary clusters of piles driven up and down stream. When necessary to open bridge, pontoons can be temporarily removed by a tug or a means similar to that used in method No. 1.

The application of this method is limited to streams or lakes in which there is little or no change in height of water, and it is further open to the same objections as the first scheme or any other scheme involving pontoons, that it is slow in operation.

SIXTH METHOD :

Use a temporary span somewhat shorter than the opening occupied by the wrecked arm, driving a temporary pier just in front of the rest pier or pivot pier, as is most convenient ; float the temporary span in on a couple of pontoons or lighters, pump sufficient water into the pontoons to allow the temporary span to settle down on these piers, and when necessary to open the drawbridge, run the lighters under the temporary span, pump out the water and lift it, pulling the entire lighters and span away with one or two tugs.

Another variety of this method would be to support the girders of an ordinary locomotive turn-table, if these are available, upon a lighter, tow the whole arrangement into the opening and support the ends of the turn-table on temporary piling so as to make the track good, then lower the supports on the lighter. When necessary to open the drawbridge, jack up the center of the turn-table on the lighter to clear the ends and tow the whole apparatus out of the way.

This is the slowest and least convenient method of any but may be the quickest way of getting both track and river into operation, as there are few large railroads which have not one or more idle spans, probably too light for heavy service, which can be made quickly available for such purposes as this.

C. F. Loweth of the Chicago, Milwaukee & St. Paul Railway Co. suggests that the wrecked arm might be counterweighted as above, shortened one or more panels and a temporary bridge built out so as to meet the shortened end of the wrecked arm, or a bridge be put in upon which the wrecked arm would be blocked up for the passage of trains, and such temporary

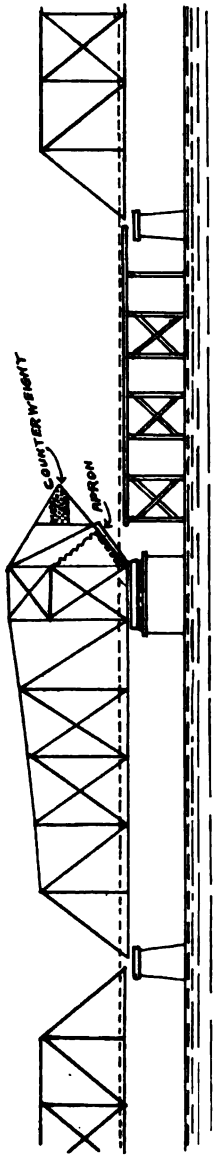


Fig. 15. With report No. 8, by Mr. Isaacs.

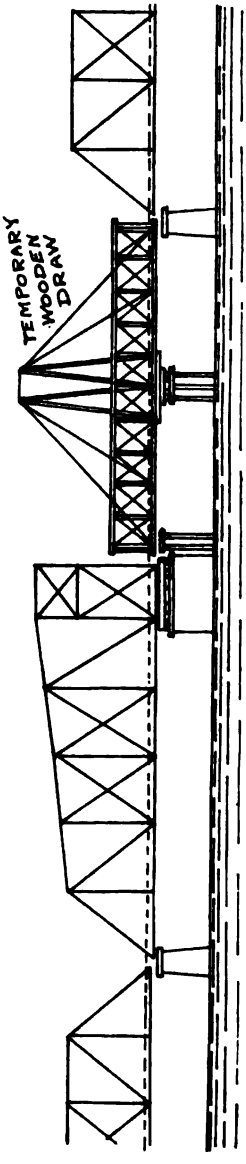


Fig. 16. With report No. 8, by Mr. Isaacs.

strengthening done of the truss as would make it strong enough to permit of swinging.

H. H. Eggleston of the Chicago & Southeastern Railway and J. P. Snow of the Boston & Maine Railroad both make the suggestion that in case the damage to the wrecked arm is not extensive, temporary reinforcement can be added to the damaged bottom chord or end post, which, of course, would be a perfectly feasible plan. But this is not the case contemplated in the question, which is the complete wreck of one arm of a drawbridge.

Henry Goldmark of the Canadian Pacific Railroad writes a letter on this subject, which is so interesting, that I think it should be given in full and is attached hereto as "Appendix." The case which he cites was not exactly that contemplated in the question, being merely the means of restoring traffic over a wrecked drawbridge at a time when there is no water traffic, and which can as readily be accomplished by simply building a trestle or running falsework over both openings, after which the drawbridge can be erected in the usual way at leisure, but the letter contains much that is interesting and relevant to the subject.

Respectfully submitted,

JOHN D. ISAACS,
F. E. SCHALL,
GEO. C. NUTTING,
W. M. NOON,
A. MCNAB,
GEO. W. ANDREWS,
Committee.

APPENDIX.

MONTREAL, March 13, 1903.

John D. Isaacs, Esq., Asst. Engr. M. of W. S. P. Co., 4 Montgomery St., San Francisco, Cal.

DEAR SIR: Replying to yours of February 25, as chairman of the Association of Railway Superintendents of Bridges and Buildings, I would say that I have not had any experience in a case such as you mention. I have, however, in at least one case been obliged to run a train over one arm of an important drawbridge of a deep stream while building a new draw span under the other arm. I did this about a year ago in building the bridge across the Missouri at Atchison, Kan. This draw was 360 feet over all, with highway floor on the same level, the space between the rails and on either side being plank. On account of ice running, it was not safe to close more than one arm by falsework at any one time. When calculating the stresses I found that each arm would act fairly well as a simple span if the other arm were entirely removed. Some of the web members required reinforcing by temporary rods.

The falsework was then put in the other arm, the truss work taken down and the new half truss erected; the piles were then removed in this arm and a pile falsework driven under the other arm, and this in turn was renewed by new steel. In this case it was not necessary to keep either draw arm open for navigation as the work was done in the winter time. The circumstances, however, impressed me with the desirability of building each arm of all drawbridges of sufficient strength and of such construction as to make it possible to erect them independently. This involves additional material in only a few web members towards the ends of the span and at little extra expense. In the case I mentioned above, where one arm was erected after the other, there was considerable difficulty in adjusting the elevation of the draw span at each end to the adjacent fixed spans. These had to be put in before the second arm of the draw was in place. It was, therefore, impossible to know just what the deflection of the draw from its dead weight would be; consequently, I had to raise one arm of the draw on the falsework entirely clear of the falsework and readjust the elevation at the central drum by several shim plates until the end of the span was just a little lower than the fixed span adjoining, so that the lifting apparatus could be made to produce the exact level track.

Yours truly,

HENRY GOLDMARK.

V.—Best Method of Protecting Solid Floors of Bridges.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings :

Your committee appointed to investigate the above subject No. 5, beg to submit the following report :

Circulars were sent to a number of railroad engineers, containing the following queries :

1. What shape are the sections of solid floors in use on your road?

2. Are the track rails supported directly to the steel floors?

3. Are the trough sections lined with asphaltum or other material for protection and drainage ?

4. Are the trough sections filled to top with ballast to carry tracks, or do you place track ties into trough sections ?

5. Do you fill troughs with concrete to top of trough and then ballast ?

6. Do you fill troughs with gravel and then place a solid covering of asphaltum on top of same on which to carry the ballast ?

7. What style of drainage do you use for trough floors ?

8. Do you paint the steel floor before any protection is placed in the troughs ?

9. How do you protect the underside of solid steel floors to shield them from the action of gases, etc., caused by trains passing under bridge ?

10. What is your opinion regarding the use of I's covered with steel plates for solid floor bridge with the rails attached directly on the plates ?

11. Have you used a solid floor of reinforced concrete ? If so, kindly give your opinion in reference to same.

12. Have you ever used a creosoted wood lining, resting on I-beams for a solid floor bridge, to support ballast ? What, in your opinion, would be the maximum life of the creosoted flooring ?

ANSWERS TO QUESTIONS SUBMITTED.

Mr. J. C. Bland, engineer of bridges, Pennsylvania Lines West of Pittsburgh, sent us the following information :

1. Triangular and rectangular troughs.

2. In two or three cases, due to limited depth from rail to clearance, the rail rests on the troughs, with, however, fibre mats

interposed. We have no cases where rail rests directly on metal work.

3. Trough sections are in some cases covered with rock asphalt ($\frac{1}{4}$ of an inch thick) for protection, and asphalt is so arranged as to shed surface drainage.

4. Troughs are filled with concrete or with stone ballast, and 6 or more inches of ballast above this to bottom of tie. In no cases have we any ties set in troughs.

5. Yes; with concrete or stone ballast.

6. No; never use gravel.

7. When troughs are filled with concrete an asphalt covering is used to make water tight and to shed surface water. When troughs are filled with ballast, the troughs have one-inch holes in them, and drainage carried away by shallow channel irons.

8. Yes; two heavy coats of red lead paint.

9. A variety of ways: (a) Concrete on expanded metal. (b) A paste made of concrete and red lead. (c) Tongued and grooved boards made into a ceiling.

10. Would not use this method. Much too noisy; do not like the plan of having rails directly on the flooring.

11. No; have used rails and concrete, but concrete was only considered a binder or filler.

12. Yes; we are just using creosoted plank laid on metal floor system; cover creosoted plank with asphalt for making waterproof, and formed so as to take off drainage. On this 8 to 10 inches of ballast. The life of this creosoted timber I believe to be fully 20 years.

Mr. A. F. Robinson, bridge engineer of the A., T. & S. F. Ry. Co., sends the following:

1. For solid floors in bridges we use transverse I-beams spaced from 12 to 20 inches apart centers and resting upon the bottom flanges of the girders, of stringers, or upon shelf angles riveted to the same. On top of these I-beams there is a course of creosoted timber from 2 to 5 inches in thickness and above this the course of ballast. Where we are using deck girders with a ballasted floor, we have covered girders solid with a course of creosoted timber, the thickness varying to suit the space between the girders, and top the same out with the regular course of ballast. In both of the above schemes the metal work is left entirely uncovered so that all parts can be examined and can be cleaned and painted by the ordinary methods.

2. We have one bridge, a 90-foot girder span, in which the I-beams are topped out by a steel deck plate and the rails are fastened to the running plate which rests on top of the deck plate without the use of ties. We have found no method by which

we can with certainty protect this kind of floor from the effects of rust. It is also extremely noisy under traffic, and in Chicago floors of this character will become such an intolerable nuisance that the city will force the railroad companies to cover the same with ballast. In Chicago where a large percentage of track elevation bridges have been made in the above manner, the deck plates have been covered with a gravel tar roofing protection. I have noticed that these floors do not leak for perhaps an hour after the rain storm begins, but that they are continually dripping water for several days after the storm. In many cases where I have cut into this gravel tar roofing, I have found water or moisture on top of the deck plate underneath the roofing, and the deck plate has always been very rusty. I do not believe we will ever find a method by which we can protect a deck of this character.

3. No. 4. No. 5. No. 6. No.

7. We have no trough floor bridges on the line. The only solid floor structures are as above noted, made with I-beams which are covered with creosoted timbers resting directly upon the tops of the girders. Where we are obliged to give a water-tight floor, the clear head room for street underneath is fixed at center of street crossing. One end of the bridge is then tipped up and the other down sufficiently to make the timber floor drain from one end to the other, the tracks being laid to grade, the ballast being deeper at one end of the bridge than at the other. Where we have to make a water-tight floor the material is tongued and grooved and the seams are calked with oakum or with cotton and filled with calker's pitch. After calking the top of the floor is covered with one heavy coat of hot coal tar.

8. We use no troughs or use no type of steel floor which cannot be painted at any time without disturbing the ballast.

9. We have of late been covering the entire lower surface of the bridge with a course of ¾-inch matched and dressed flooring and directly over the track which passes below the bridge we have fastened on a strip of hard steel which extends the whole width of the bridge and which is usually from 36 to 46 inches in width.

10. While this type of floor undoubtedly carries the load properly, there is no method of which the writer has any knowledge by which we can protect the deck plates and the I-beams from the serious rust action. This pattern of floor is such a terribly noisy affair that it should not be used in any inhabited county.

11. As to the use of creosoted wooden lining resting upon the I-beams, I think the questions above noted will explain our practice fully.

If you should desire blue prints showing our practice, I will be glad to send the same to you at any time.

Mr. Benjamin Douglass, bridge engineer of the Michigan Central Railroad, makes the following report:

1. We use I-beams with plate on top and riveted to them. Ballast supported directly by the plate and plate by the beams.

2. Only when the floor has got to be so thin that there is not room for 6 inches of ballast under the tie.

3, 4, 5, 6, 7, 8. Do not use trough sections.

9. We have never used anything but paint to protect the underside of steel floors. If they are exposed to much gas, something better should be used, but just what I do not know.

10. I think it is better to raise the rails so that bolts will not pass through the floor plate, as they will have to do if rails rest directly on the plates. We have, however, one or two bridges where the rails rest directly on the plates and these are reasonably satisfactory.

11. No.

12. We have never used this kind of floor. My opinion concerning its life would not be very valuable as I have had no experience with creosoted timber.

There is one question which you will probably like to have answered which was not included in your list and that is the method of protecting the floor plate under the ballast. In the type of floor we use, our method is to heat the floor either by means of fire suspended underneath, or by the flame of a torch applied in top. When the floor plate is quite hot, we pour on melted asphalt and form a coating nearly or quite ¼ inch in thickness, applied as two coats. This has so far proven very satisfactory. The first bridge of this type which we put in was moved to another location last year, and after the ballast had been removed, the coating was found in perfect condition and the plate underneath absolutely free from rust except a little scale such as is on all material when first erected.

Mr. H. Fernstrom, chief engineer N. Y. C. & H. R. R., sends the following answers:

1. We either use a solid trough floor, consisting generally of vertical web plates, horizontal top and bottom plates and angle irons at corners for riveting the same together, or we build solid floors of I-beam sections with a solid plate on top, which we generally make 7-16 of an inch thick. The latter construction is to be preferred.

2. We have only one place where track rails are supported directly on steel floors.

3. We line trough sections with an asphaltum composition, and the bottom with an asphaltum concrete (asphaltum and

gravel mixed), shaped to the bottom of the trough so as to give drainage. This layer varies in thickness at the bottom of the trough from 1½ to 3 inches.

4. Trough sections are not filled to the top with ballast to carry tracks, as, if this could be done, we would prefer the I-beam and plate. Our object in using trough floors is invariably to get the ties into the trough sections and thus reduce the distance from base of rail to under clearance of structure to minimum.

5. We have in no case used concrete in the troughs.

6. For reply, see No. 3 above.

7. As before explained, asphalt concrete at bottom of trough is shaped so as to afford drainage. At the lowest point where this layer would be about 1½ inches thick, gas-pipe drainage nipples are placed in the bottom of the troughs passing through the same; the gas-pipe being threaded and screwed into the bottom trough plate.

8. The ballast side of steel floor is first painted with red lead and then given a coat of refined asphaltum and straight run coal tar pitch heated to a temperature of 300 degrees Fahr. and mixed 10 parts of the former to 30 parts of the latter.

9. The underside of solid floors is painted the same as the other steel work—two coats of red lead and two coats of New York Central asphaltum varnish. We have in one case, where the structure would come very close to the smoke stack of passing locomotives, suspended a shield made of expanded metal lath plastered with cement mortar. This has been in service about three years and has been fairly successful.

10. An I-beam and steel plate solid floor is the best solid floor construction, but would not recommend fastening the rails directly to this steel floor; prefer to have the rails on ties and ballast under same. Our experience is that this ballast on the solid floor bridges practically takes up all impact from the drivers of engines and thus reduces the live-load stresses far more than the increase in stresses caused by the weight of the ballast.

11. Have never used solid floors of reinforced concrete.

12. Have never used creosoted wood lining resting on I-beams for solid floor bridges to support the ballast.

I believe such creosoted flooring would probably last fifteen years.

Mr. L. Bush, chief engineer of the Del., L. & W. R. R., makes the following reply:

1. The shape of our sections of solid floor bridges is of box type, made of angles and plates or channels and plates.

2. Track rails are not supported directly on the steel floors.

3. We fill the trough sections with concrete.

4. We use ballast on top of the concrete floors in troughs.

5. Answered above.

6. No.

7. We use pipes tapped into the bottom of trough sections for drainage.

8. We paint the floor before filling in with concrete.

9. We protect the under side of solid floor bridges by putting on a shield of matched timber.

10. We have one bridge made of I-beams covering with steel plates which requires a great deal of attention in the way of painting to keep the ⅜-inch plate covering from rusting. It is also difficult to properly insulate the rails where signaling is required, and on the bridge referred to we have provided a rail channel running longitudinally under the rail with flanges turned upward. Immediately under the rail and between the flanges of the channel and the railroad rail, we use a timber block and find that the elasticity of the side blocks is such that we do not have any trouble from bolts working loose. This bridge has been in use over three years, and we have never had a failure of lack of insulation.

11. We have used solid floors of reinforced concrete by putting in railroad rails in the tension flange of the concrete top. Where the span exceeds eight feet we have used old "I" beams from our old bridges, placing the bottom flange flush with roof of concrete top. We have in the last three years replaced many open short span bridges with this type of construction and have not found a single instance where the concrete tops have cracked.

12. We have never used creosoted wood lining resting on I-beams for a solid floor bridge to support ballast. We have a shallow floor bridge that we are using which consists of I-beams, spaced 4 foot centers with stringers, on which are placed ties in the ordinary way. The rail is placed in a rail channel attached to the ties which forms a perfect insulation and the covering is made of matched flooring treated as a gravel roof. I enclose you a blue print, showing two types of water tight floors that we have used and as described above. I consider the gravel roof floor a very good type of construction, and have succeeded in making a perfectly water tight floor and it is the quietest floor we have. The roof can be repaired by the ordinary roofer.

Mr. J. Tuthill, chief engineer Pere Marquette R. R., replies in the following way:

1. The floor that we will use will be I-beams covered with steel plate.

2. The track rails will be supported directly on steel floors.

3. We have no trough sections.

The same answer will apply to questions Nos. 4, 5, 6, and 7.

8. I expect to paint the steel floor and cover it over with a coating of asphalt to protect the upper surface.

9. We have had no such conditions to meet.

10. I consider I-beams covered with steel plate the best floor for solid steel bridges, but would prefer one foot or more ballast in which to lay the ties, rather than fasten the rails directly to bridge. Where it is necessary to fasten the rails directly to the plate, I would put bearing plates under the rails at each I-beam.

11. I have never used solid floor reinforced concrete.

12. I have never used creosoted wood lining resting on I-beams for solid floor bridge to support ballast, and have had no experience with creosoted wood, so have not much of an idea of the minimum life of such a floor, but would think that it would last somewhat longer than creosoted wood buried in earth as the lower end of post.

Mr. F. E. Schall, bridge engineer of the Lehigh Valley Railroad, makes the following report:

1. Square or rectangular troughs.

2. Yes, in some cases where the height of floor is limited, the rails rest on a distributing plate riveted to troughs; the rails are fastened by means of clips and bolts; both the clips and bearing plates are insulated by fibre mats on account of electric block signals.

3. Yes, with asphaltum, but the lining does not give entire satisfaction.

4. We have had no such case on the Lehigh Valley R. R. I have seen it on other roads but do not think much of it.

5. No, we have not used this method.

6. We have used this method, lining troughs with asphaltum, using small broken stone to top of troughs, and then covered the whole surface with 1½ inch thick asphaltum concrete, and ballasted track on top of the asphaltum; this does fairly well, but is not entirely satisfactory.

7. A 2-inch diameter short galvanized iron pipe is screwed to trough at center, and asphaltum lining shaped to carry drainage to pipe

8. Yes, but if rust can be kept from steel before asphaltum lining is placed, it is not necessary, since the hot asphaltum will destroy the paint.

9. By paint only, but should like something better.

10. I should prefer placing 2-inch asphaltum covering on top of plates and then ballast with stone or gravel account lining of tracks.

11. No.

12. No; I think it will answer the purpose, where proper height can be had; it ought to last at least 25 years if properly treated and not damaged by tamping of track.

In addition to the above report, your committee received the following letter from Mr. J. P. Snow, bridge engineer of the Boston & Maine R. R.:

The Boston & Maine Railroad have one trough floor bridge filled with ballast only, several small bridges with longitudinal troughs or I-beams, some filled with concrete and some with brick arches and ballast, one with I-beams and brick arches with ties resting on the beams without ballast and several large plate girder bridges with plates riveted to the tops of cross floor beams. On some of the latter the rails are supported directly on the floor plates, and on others we have timber ties intervening. All of these bridges are quite satisfactory. We use only ordinary paint like red lead or graphite to protect the plates.

The floor beams of the plate floor bridges are 2-foot on centers, and in all cases are built beams. Where ties are used the beams are built shallow at the center and deep at the ends and the ties hewn to fit. A 4-inch by 12-inch gain is cut in the lower side of each tie at its center, which makes an ample channel for water. The floor is given a slight camber to cause water to run to the ends of the bridge, where a 4-inch hole is cut through the plate, a cast flange riveted on below, and a pipe built into the masonry to carry away the water.

Where no ties are used the floor beams are built with level tops, but a camber is built in the floor and drainage provided for in much the same way as above described.

The single bridge, with trough floor filled with ballast, has 1¼-inch holes at each end of each trough, which deliver water into gutters running lengthwise and crowned at the center of the bridge.

We have a few bridges with solid 4-inch plank resting on I-beam stringers placed quite near together. The rails lay on the plank. The plank are matched and calked, making a tight and satisfactory floor.

Mr. Wilbur J. Watson, bridge engineer of the Osborne Engineering company of Cleveland, writes the following:

We are sending you under separate cover, a blue print, showing the solid floor which we have designed for use on the Buffalo grade crossing viaducts. We are using similar floors on ordinary highway bridges which we are designing, and in several cases where the panel length is not too long, we are replacing the usual steel stringers with concrete-steel stringers. We find that this style of construction is actually cheaper in first cost, in many instances, than the usual construction of steel stringers and white oak floor, besides possessing the added advantages of permanency and rigidity.

It is our opinion, however, that concrete-steel construction should be used only when carefully designed and inspected by competent persons, this being more essential for this class of construction than for the older and better understood methods.

Mr. C. P. Austin, of the Boston & Maine R. R., sends the following information:

I have only one bridge that has a steel floor on my division. It is about two miles outside the city of Lowell, Mass., with a highway underneath. This floor is sheet steel ⅜ inches thick, with a waterway in the center of track, with outlet at the ends of bridge down to the highway next to the abutment. This bridge is 46 feet 6 inches between abutments and was built in 1896, and was painted at that time with graphite paint, and has had two coats since. I send a tracing of a section of this bridge showing the ties laid on the deck. There may be some more of these bridges on some of the other divisions, but I do not know of any.

Mr. C. F. Loweth, engineer and superintendent bridges and buildings, C. M. & St. Paul Ry., Chicago, writes the following:

Outside of track elevation work in this city, we have used but very few solid or ballast floor bridges, and those only of short spans, where we have made a floor of plates carried on Z irons or beams laid on the stringers or girders, and on top of this plate floor there has been placed the ballast. We have no trough section floor. At such bridges as I refer to we have provided for drainage by giving the bridge a floor grade, allowing for a greater depth of ballast at one end than at the other. We have painted these thoroughly before putting ballast on with the best paint obtainable. We have none of these structures over our tracks. We have in use a bridge floor of reinforced concrete. We are using a great many square top box culverts made of concrete, with steel rails, beams, or corrugated or twisted rods in the cover, depending upon the length of span. Formerly we used rails almost exclusively, but have within the

last two years abandoned this, and for the long spans used rolled beams, and for short spans used corrugated or twisted bars. In a great measure this type of culvert has taken the place of the small ballast floor bridge as above, the same depth below base of rail being required for either structure.

We have in use a creosoted wood lining resting on I-beams not carrying ballast, and from experience I am not prepared to say what lifetime could be expected of such a construction. I should think that with proper creosoting a lifetime of twenty years could be gotten. I have the matter of this type of construction now under consideration.

Mr. George F. Powers, general foreman bridges and buildings of the C., L. S. & E. R. R., sends a statement of cost of asphalting Noble Street Subway, Chicago, showing the average cost, including labor and all materials for cleaning the steel work and asphalting the same, this average cost being $.08½ per square foot.

A. O. Cunningham,
Geo. F. Powers,
D. W. Lum,
Albert C. Keith,
C. P. Austin,
F. E. Schall,
Committee.

DISCUSSION.

President.—I would like to call attention to the fact that this subject is the best method of protecting solid steel floors of bridges. It refers to the top of the floor. The subject that we continued was the best method of protecting overhead structures from blast of locomotives, and that subject will be reported on next year by our action of yesterday, and this subject seems to me to involve the protection of floors of bridges from drippings from refrigerator cars and such like injurious substances.

Mr. Reid.—We have used asphalt and gravel, among other things, as a protection, though with very little satisfaction. It does not seem to stick well. We put it on hot and the gravel on over it, but it does not stick and peels off after a while, leaving no protection, and has not been satisfactory. It has been suggested by one of our roadmasters to use a Port-

land cement wash of Portland cement and water, and paint the stringers and floor beams with that. If any of the members have had any experience with a Portland cement wash, would like to hear from them. If the thing can be put on thick enough, and would also stick close enough to the iron, probably that might be a good protection. But this question is a vital one because salt is knocking our floors out badly.

Mr. Snow.—In regard to the Portland cement wash that Mr. Reid speaks of, you must remember that Portland cement is not water proof, and if the water soaks through the cement, which it will, it will rust the iron more or less, although it is worth trying and has been used in some cases very successfully. I have never had any experience in using it just as is suggested, but did try it on iron work which was submerged at every tide—that means twice a day—in salt water. In a few weeks the rust began to show through the cement, and we cut it off with the sand blast and put on paint. I think if the paint is the right kind, it is better than cement wash. In regard to the subject under discussion, I think the method of Mr. Douglas of the Michigan Central, as suggested in the committee report, is one of the best things that has ever been tried. I refer to heating the iron before the protecting coat of asphalt is applied. If you heat the iron, I think you have got something a little on the order of an enamel, and I believe it would be more durable than anything else.

Mr. Banks.—Mr. President, I think good paint is the best thing to go next to the iron, but it should be applied to a clean surface, and when this is done I think it is better than Portland cement wash. I favor a good paint.

Mr. Sheldon.—Mr. Reid spoke of trying asphalt on his iron, and could not make it stick. I would say that we tried in on good, clean iron, and we got better results; and the matter of heating the iron is a good suggestion. We tried that in the case of some water-tank hoops with complete success, and I think that if there could be some method devised to warm the iron sufficiently on our bridges before applying the asphalt wash, that we could make it stick and would get better results.

Mr. McIntyre.—I would like to know what is considered the best kind of paint to use.

Mr. Snow.—Cheap paint is not worth putting on.

Mr. Reid.—I was going to ask Mr. Snow if the Michigan Central people used this preparation on ordinary floor beams, and as to the question of heating the floor beams, etc., to put on this asphalt, would like to ask how they do it, and if they do it under traffic and get good results in that way.

Mr. Snow.—I understand that it devolves upon me to explain this matter further. All I know as to what they did on the Michigan Central is what my friend Mr. Douglas has written in the report, and if our members would read that carefully, which I would commend to them, they would know as much about it as I do. I understand in some cases he has used a fire underneath the floor-plate, or gasoline torches on the upper surface. I think, as I read his report, that it seems this sort of heating has only been done on solid plate floors, but I do not see why it could not be extended to the tops of plate girders long enough to warm them up to the proper degree.

Mr. Montzheimer.—I had some experience in covering track elevation bridges in Chicago with asphalt. We used a gasoline torch or burner for heating the iron before applying the asphalt, and had good results. In talking about asphalt, I believe asphalt means several different things. In some cases we have had asphalt put on, and afterwards found that it was not asphalt; that is, it was not what I call asphalt, but it was asphalt to some one else. Mr. Reid stated that he did not think from his experience, so far as he had experimented along this line, that the asphalt will stick to the iron. I would say there was an overhead bridge on which we applied asphalt in 1895. The iron was heated before the asphalt was put on. It has not given a bit of trouble, and has now been on eight years. I think pure asphalt, properly heated, applied to iron which has been thoroughly cleaned and warmed, is the best protection, and will give excellent results. The iron should be heated, so that all moisture will be eliminated, otherwise the asphalt will not adhere to the iron.

Mr. A. S. Markley.—I believe, to overcome this difficulty, refrigerator cars should be constructed with suitable tanks in bottom of cars to accumulate the brine; it could be so arranged that it would be emptied automatically, or by train men at terminals. This would, I believe, be more economical than to protect the iron bridges, interlocking connections, rails, and spikes from being destroyed. The last two (rails and spikes) cannot be protected from this element, that of salt water drippings.

Mr. Sheldon.—I would say that I favor asphalt. We have some steel floors that were coated with asphalt in 1888, and have been covered with ballast since that time, and we have found them to be in perfect condition in every case where we did that.

Mr. Witt.—In regard to this discussion of protecting solid floors of bridges, my understanding is that it is a great deal more difficult to protect steel after oxidation has once commenced. For this reason the Northwestern specifies that all new work of this kind which is to be exposed to ballast shall be covered with a shop coat of asphalt paint, the iron being thoroughly cleaned and heated, if the temperature is low, before the paint is applied. In the field an additional coat of pure asphalt and sand about one inch thick is applied.

Mr. Reid.—Would like to ask Mr. Sheldon what kind of steel floors he used that asphalt on, or what shape they are?

Mr. Sheldon.—They are V-shaped trough floors, the Dawley-Francis patent.

President.—Mr. Cunningham, do you wish to say anything further in regard to your report?

Mr. Cunningham.—I was just going to remark that the method of protecting solid steel-plate floors, mentioned in the report by Mr. Douglas, is an excellent one, but I think what we should do is to try to get away from that kind of a floor if it is possible to do so. It is an expensive floor, in the first place, and hard to maintain, and a great many railroads are doing away with them and either using I-beams, spaced at certain intervals, covered with creosoted timbers, or else some other design. This scheme prevails on our road, and we are

just now experimenting with a new style of bridge floor. It is made of beams, spaced at intervals of about 18 inches, with a concrete slab reënforced with steel rods, laid on top. The concrete is made water proof by being washed with a mixture of alum and soap. I did not mention that in this report, because none of these bridges have been erected. One is being built now, and at a later date can be reported on.

Mr. Reid.—The point Mr. Markley raised a while ago about an arrangement on refrigerator cars to take care of the drip is a good one, and I think if we could do it, it would be well to take up that question with the master car builders and see if they cannot come to some concerted action along that line. So far as I know there is no paint that will stand salt brine. The salt brine will cut anything.

Mr. Steffen.—Mr. President, a suggestion was made to me this evening that seems to be possessed of some merit. It was the placing of a strip of one of the so-called patent roofing felts on the top flanges of stringers and floor beams, for protecting the steel from refrigerator drippings. I do not see anything objectionable about it, and I think the scheme has considerable merit.

Mr. Lichty.—I would like to see this tried, as well as any other practical scheme in connection with this subject, and reported upon at our next meeting, and suggest that some of the members make experiments in this line, applying as much of it as they see fit. The division upon which I am engaged does not run very many refrigerator cars, comparatively speaking, but there are others here who could give this a good test. This matter is well worthy a trial, and I think we would get some interesting results.

Mr. Steffen.—I would further state that if you take, for instance, a 12½ or 15-inch strip of one of these first-class "ready roofing" articles and place over the top flange of the stringer, the timber can be placed right on top of this without any difficulty, and the edges can be turned over by means of a clip or some other equally efficient device, and in this way have a good surface and have no steel in contact with the refrigerator drip.

Mr. Reid.—This suggestion on the face looks to be pretty good, if you could get a "ready roofing" material that will stand the wear of the ties. I had not thought of this matter before, and I will see if I cannot get that tried on the Lake Shore.

President.—I think the suggestion a good one, and think it would be well, perhaps, for the members to try that during the coming year and report at our next convention. The method of applying and the roofing that shall be selected will be a matter of individual choice, but I think we can safely leave that part without any further discussion, and allow each member to take his own best course in the matter and leave that for discussion next year. We shall be glad to hear then the results obtained from this trial.

VI.—Best Plans for Small Tool Houses, including Switchmen's and Car Repairers' Cabins, Section Tool and Hand-car Houses.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on Subject No. 6, "Best plans for small tool houses, including switchmen's and car repairers' cabins, section tool and hand-car houses," submit the following report:

Circulars asking for plans and information regarding their utility for the purpose intended, were sent to about sixty members of the Association on various railroads in all parts of the United States and Canada. Replies were received from twenty-two persons on twenty different railroads in Canada and the United States.

It would seem that the best plans for a tool house or cabin was the one which best served the purpose for which it was built.

Section tool houses should be of sufficient size to properly house all of the hand, push, and velocipede cars, be supplied with suitable racks, hooks, and pegs for the numerous tools of the properly equipped section gang. A shelf desk, for the use of the foreman to keep books, papers, letters, and notices, is needed. A loft for the storage of miscellaneous supplies not needed for daily use, keeps them in better condition than when they are left lying around under foot. A house divided by a partition, making a separate room for men, is best. This allows a place to put a stove, work bench, vise, and grindstone, and gives a room where clothes can be dried and some work done in bad weather, when men are not needed out on the road.

Car repairers' cabins should be of sufficient size to hold all supplies and tools kept at that point, and be furnished with racks for bolts, brasses, and fittings. Boxes for storage of waste, oil cans, etc. A stove and work bench with vise will be required.

Switchmen's and flagmen's cabins should be large enough to get in a small stove to heat it and have a cupboard to hold chimneys, burners, wicks, etc. A box for lanterns and oil cans. This box should be made with a cover to serve for a seat.

Buildings of this class can be made to conform to almost any desired standard, in general outside appearance, being made plain or otherwise to conform to surrounding structures or to suit the fancy or finances of the builder.

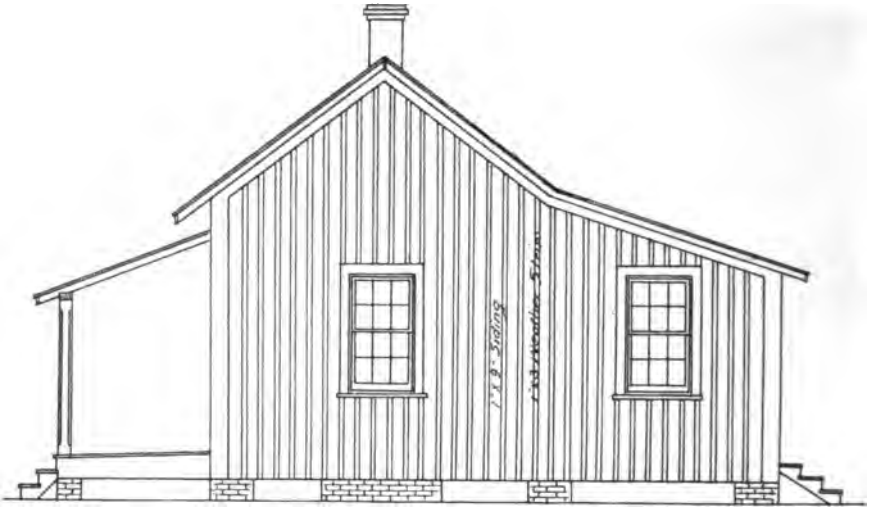
Your committee have not designated any particular plan as in their opinion being best, preferring to submit all of the plans

for inspection, allowing those interested to get the good points from all. From the number and variety of the plans it would seem as though there might be something to meet the needs of all the various conditions and requirements of this class of buildings.

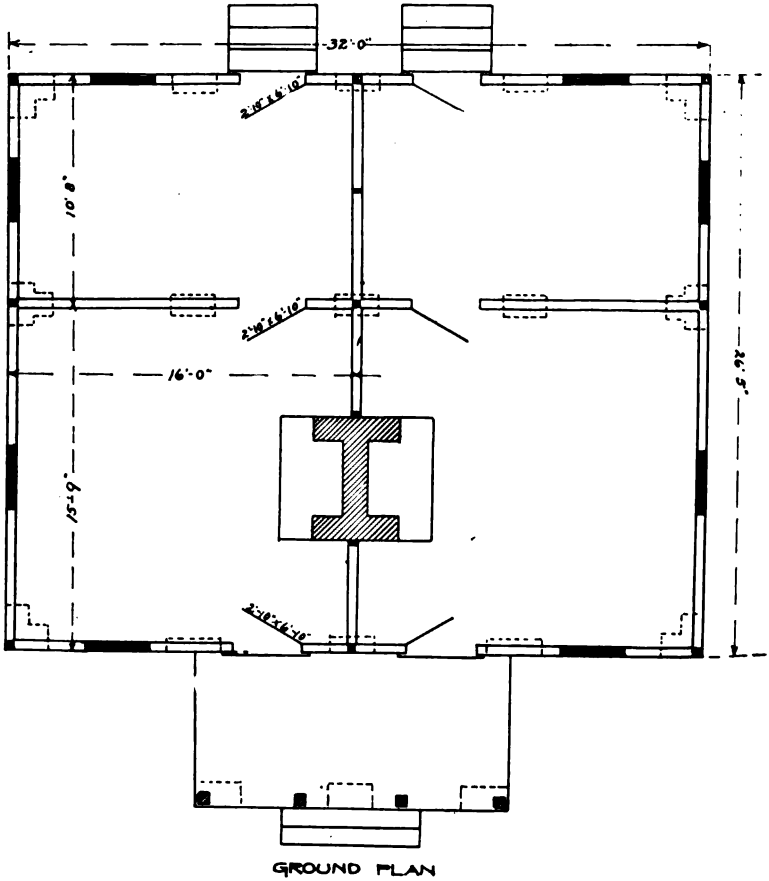
Accompanying this report as an appendix are the plans received in answer to circulars of your committee.

J. B. SHELDON,
H. E. HOLMES,
W. E. BELL,
GEO. MITCHELL,
ED. GAGNON,
C. R. WALTON,
Committee.

CENTRAL of GEORGIA Ry. Co.
Four-room Section Laborer's House
1901

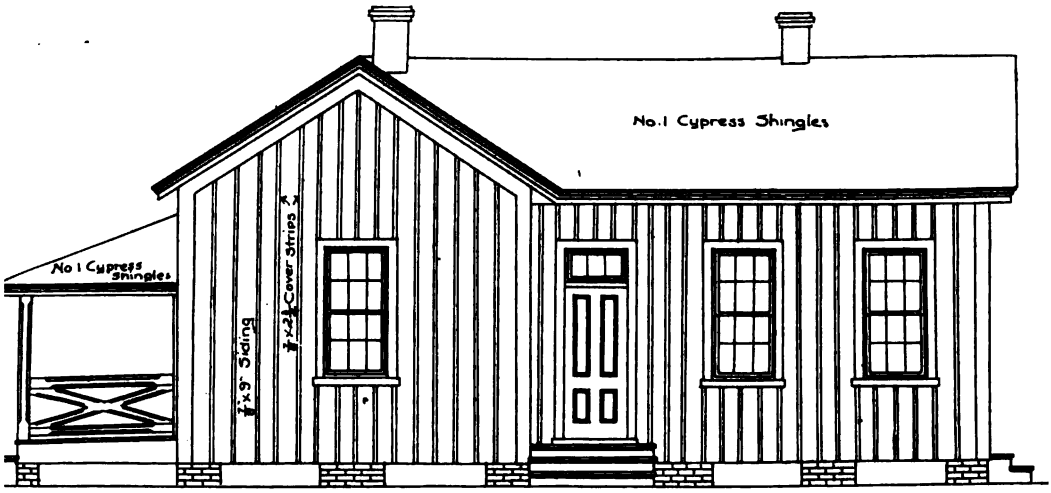


END ELEVATION



GROUND PLAN

Fig. 17. Four-room Section House, Central of Georgia Ry.



SIDE ELEVATION

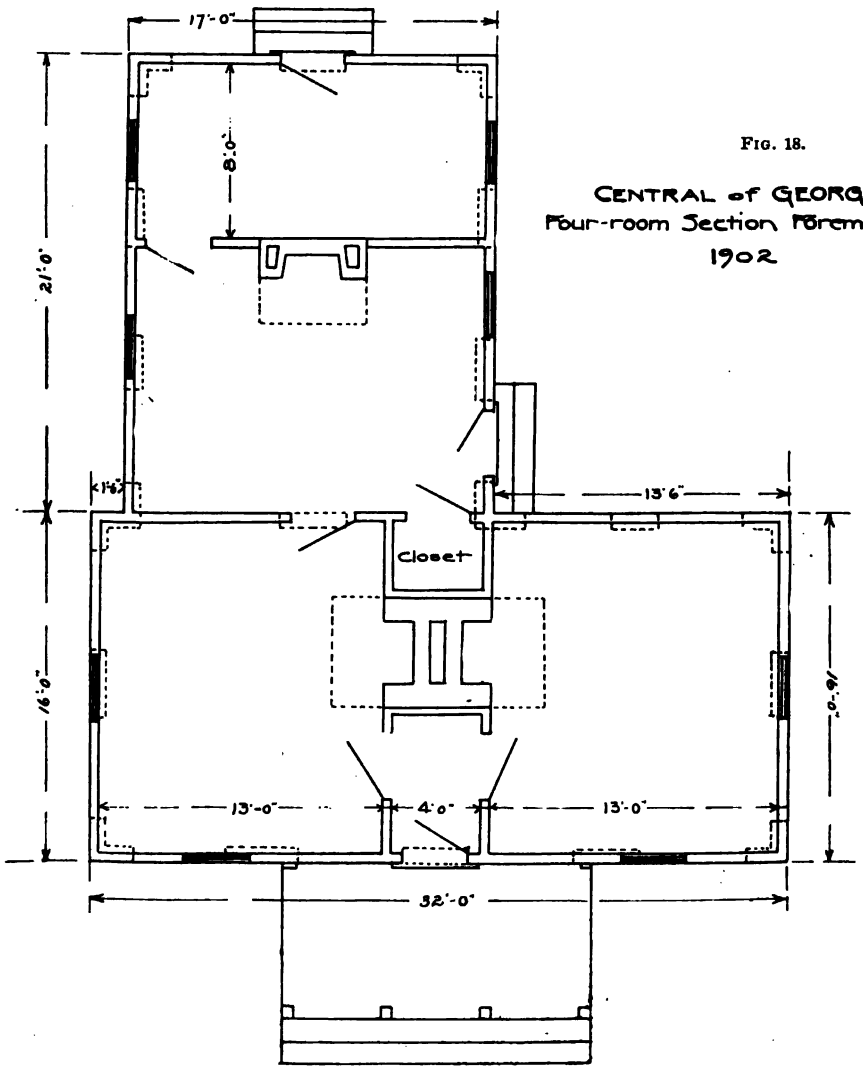


FIG. 18.

CENTRAL of GEORGIA RY.
Four-room Section Foreman's Ho
1902

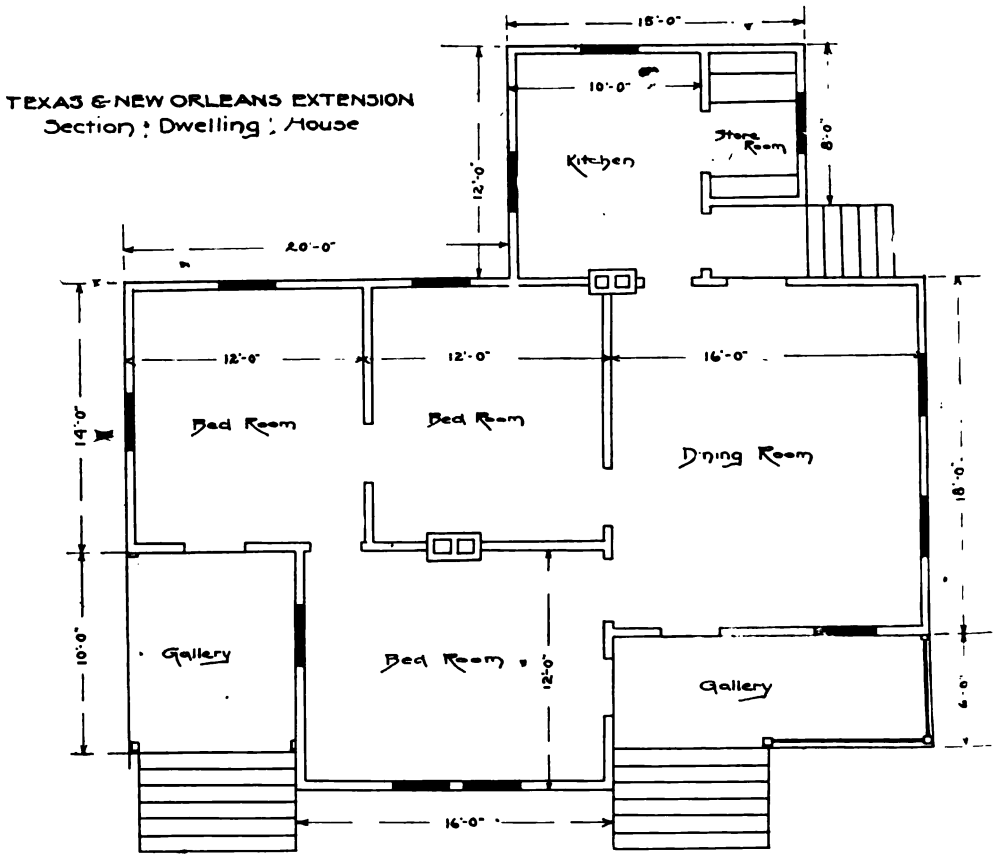
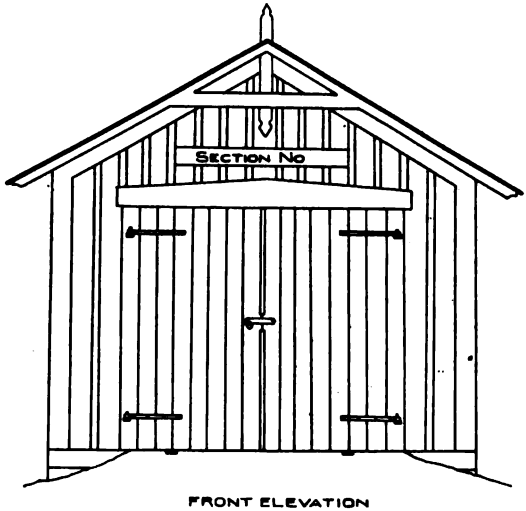


FIG. 19. Section Dwelling House, Texas & New Orleans R. R.



FRONT ELEVATION

FIG. 20.

Frame 12' x 18'.
No Windows.
Cinder Floor

CENTRAL of GEORGIA RY
STANDARD TOOL HOUSE

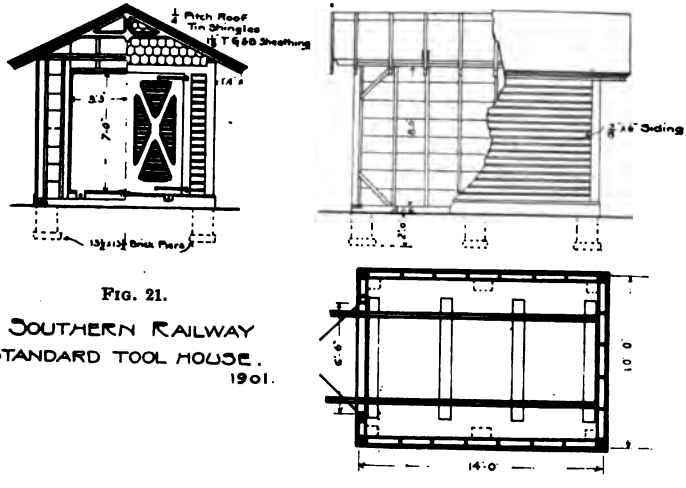


FIG. 21.

SOUTHERN RAILWAY
STANDARD TOOL HOUSE.
1901.

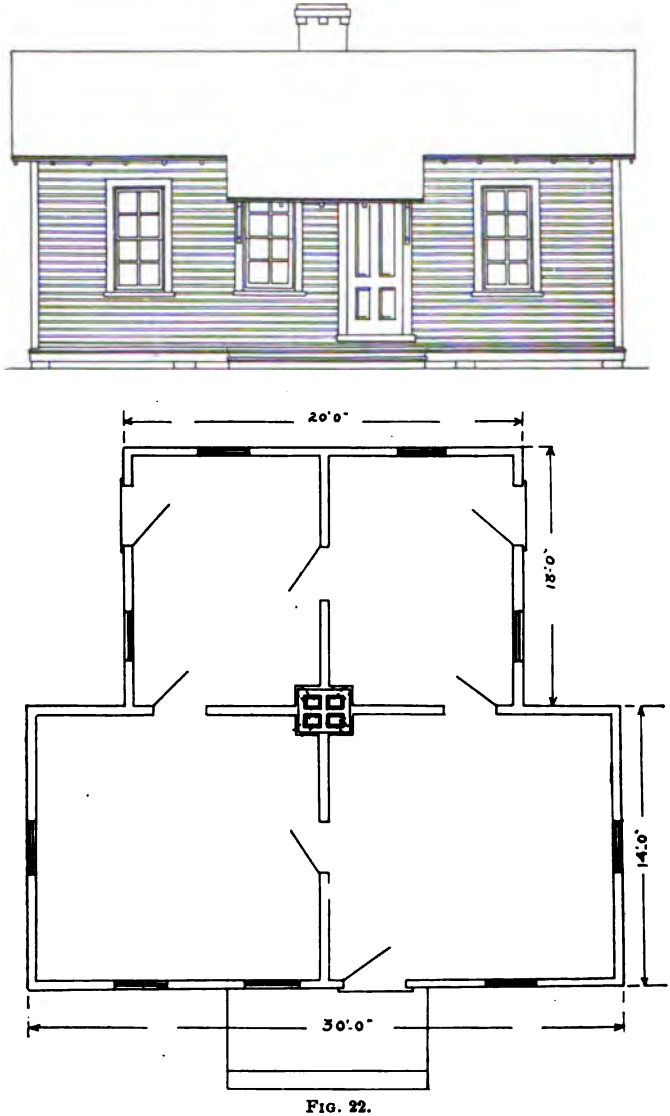
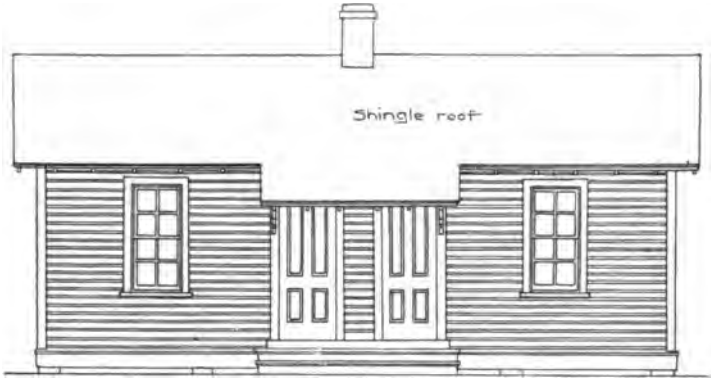


FIG. 22.

SOUTHERN RAILWAY
Section Foreman's Dwelling House



Front Elevation

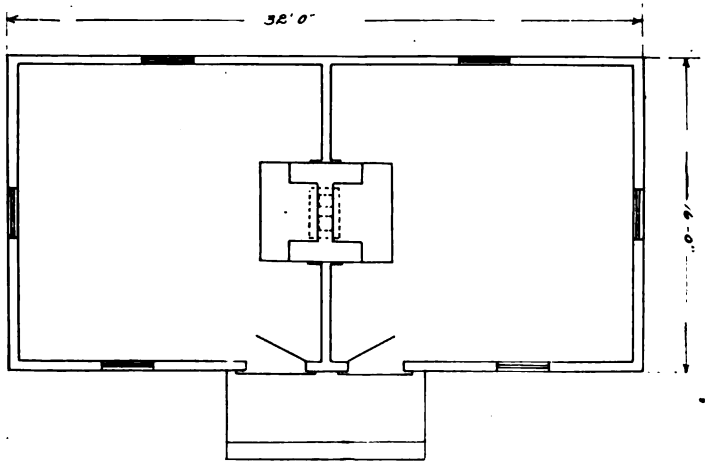
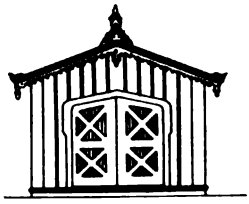


FIG. 23. SOUTHERN RAILWAY
Section Mens Dwelling House



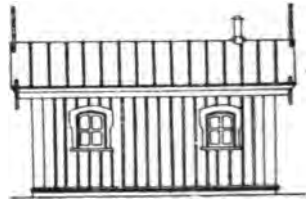
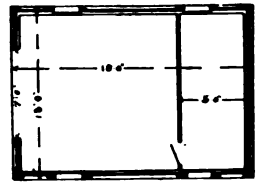


FIG. 24.

TOLEDO, ST. LOUIS & WESTERN R.R.
STANDARD HAND-CAR HOUSE



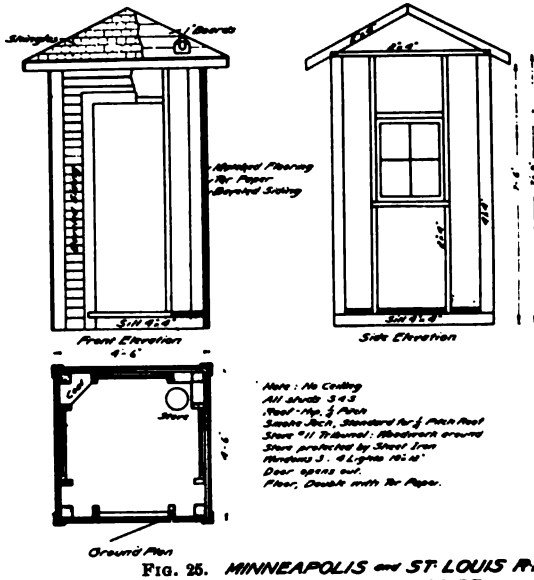
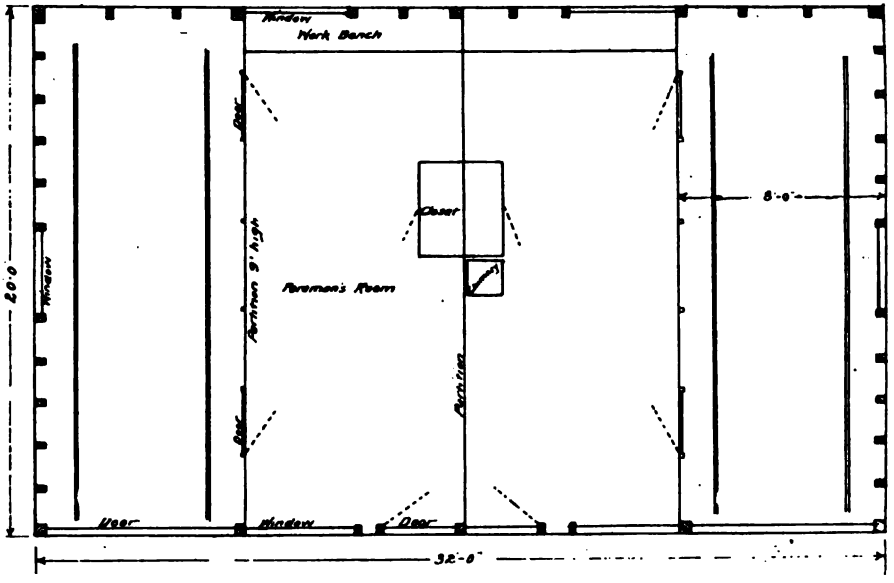


FIG. 25. MINNEAPOLIS and ST. LOUIS R.R. CROSSING HOUSE.



DOUBLE HAND-CAR HOUSE

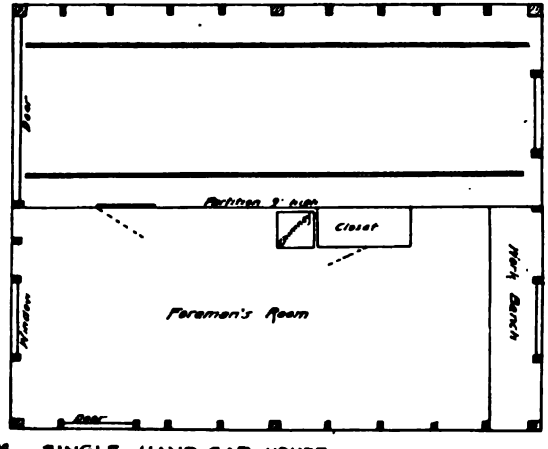


FIG. 26. SINGLE HAND-CAR HOUSE

NEW YORK, NEW HAVEN & HARTFORD R.R.

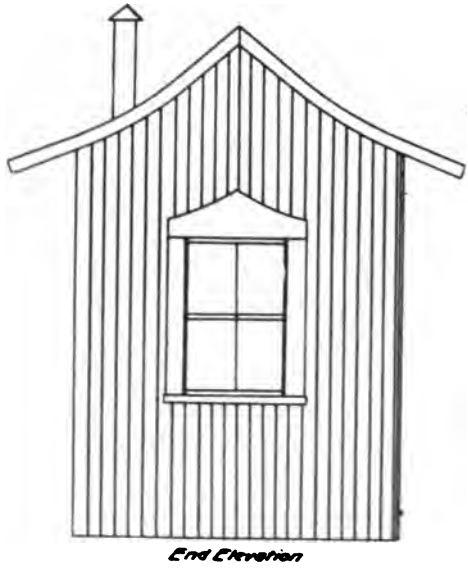
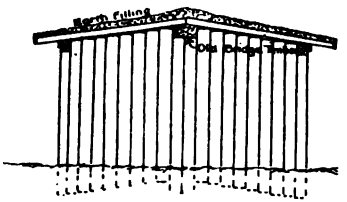
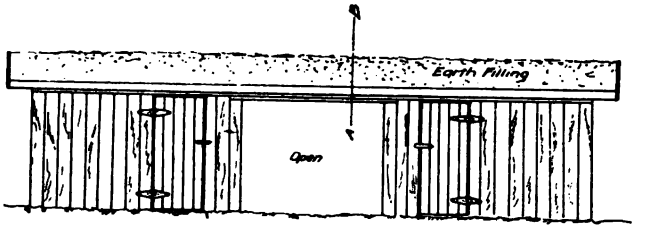


Fig. 27.

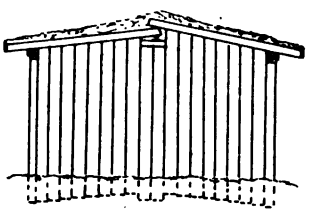
NEW YORK, NEW HAVEN & HARTFORD R.R.
STANDARD CROSSING HOUSE



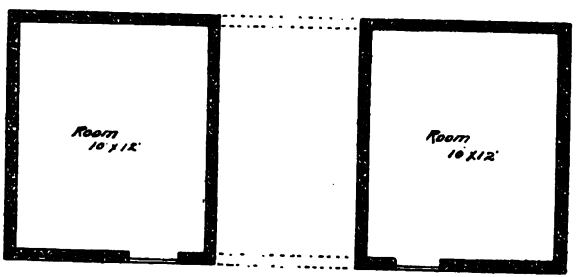
Section at A-B
Old Bridge Timber used as Ridge



Front Elevation



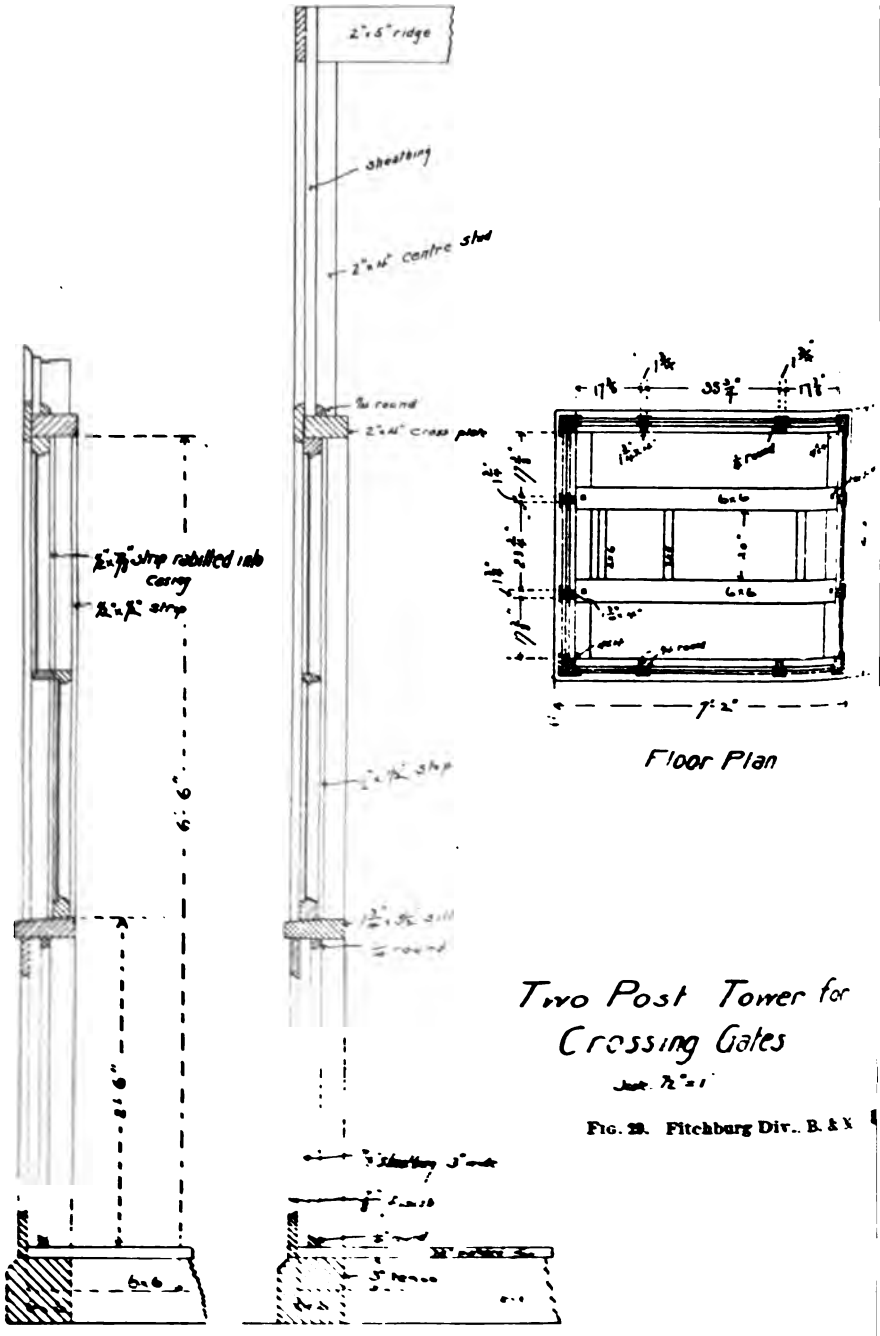
Section at A-B
Using old Track Rail for Ridge



Ground Plan

FIG. 28.

GALVESTON, HARRISBURG & SAN ANTONIO RY
EL PASO DIV
STANDARD OLD TIE HOUSE



Two Post Tower for Crossing Gates

Fig. 29. Fitchburg Div., B. & A.

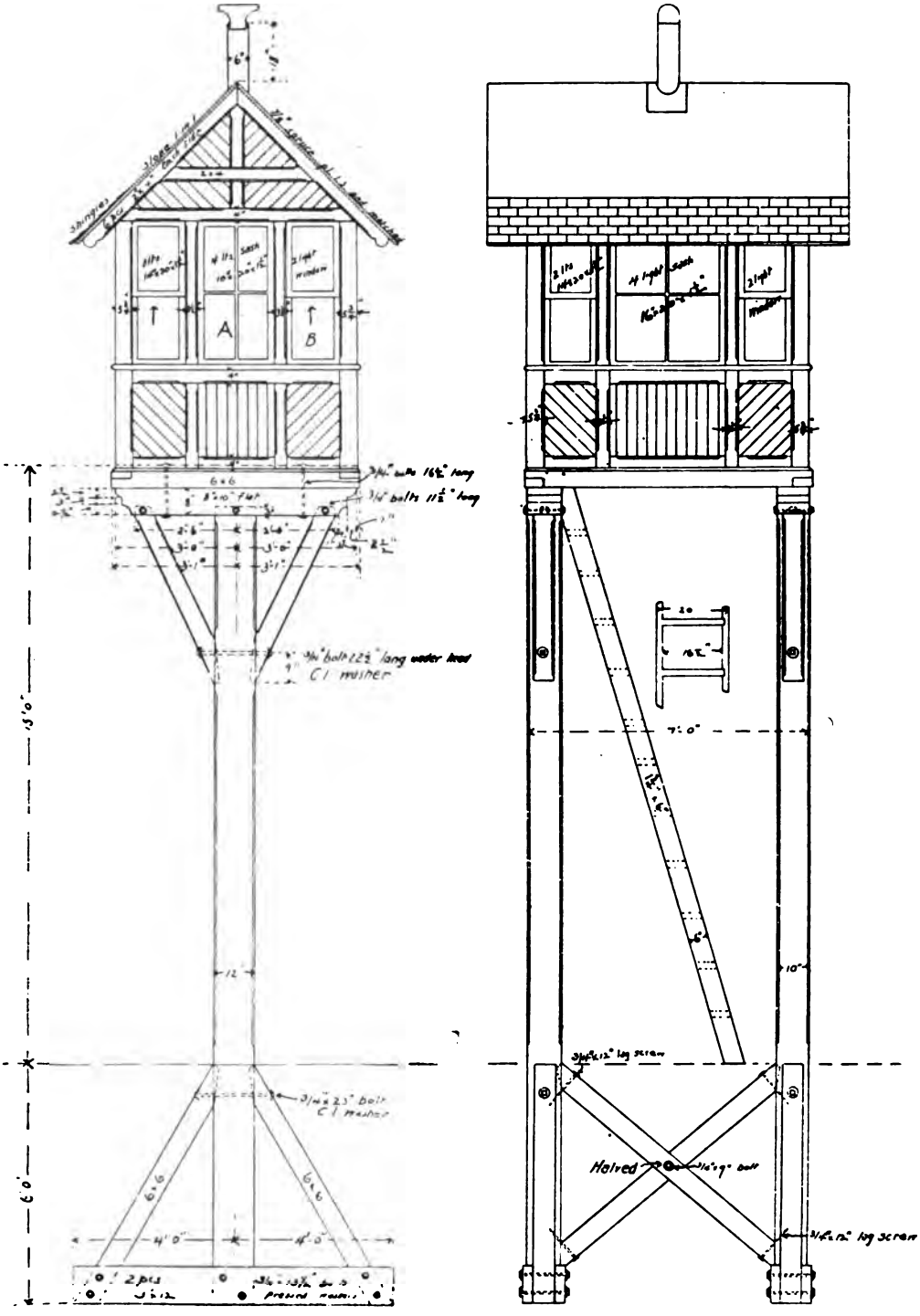


Fig. 30. Two Post Tower for Crossing Gates. Fitchburg Div., B. & M. R. R.

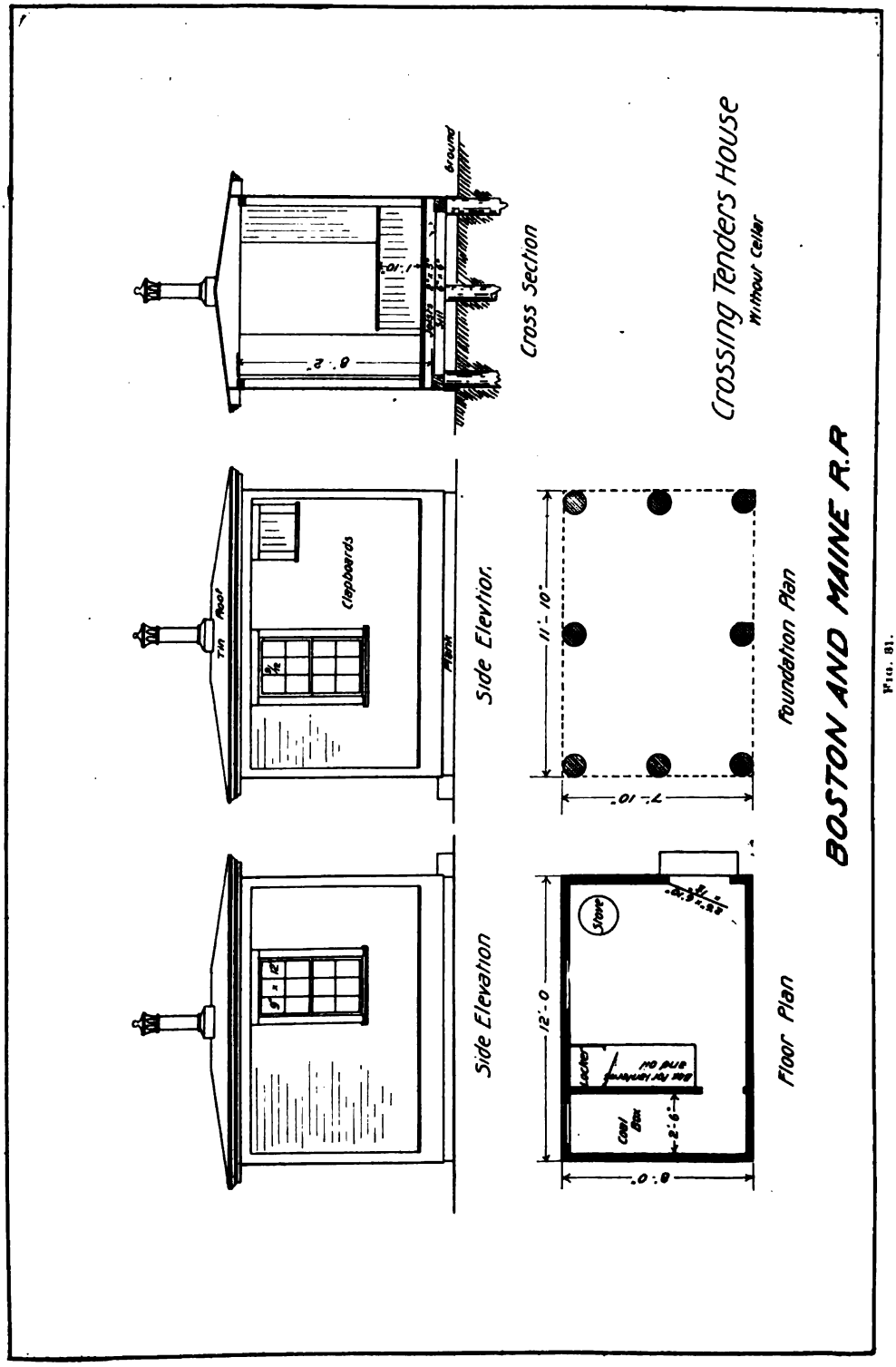

Crossing Tenders House
Without Cellar
BOSTON AND MAINE R.R
Cross Section
Side Elevation
Side Elevation
Foundation Plan
Floor Plan
Ground
Tin Roof
Clapboards
Stove
Locker
Coal Box
11'-10"
7'-10"
12'-0
10'-0

FIG. 81.

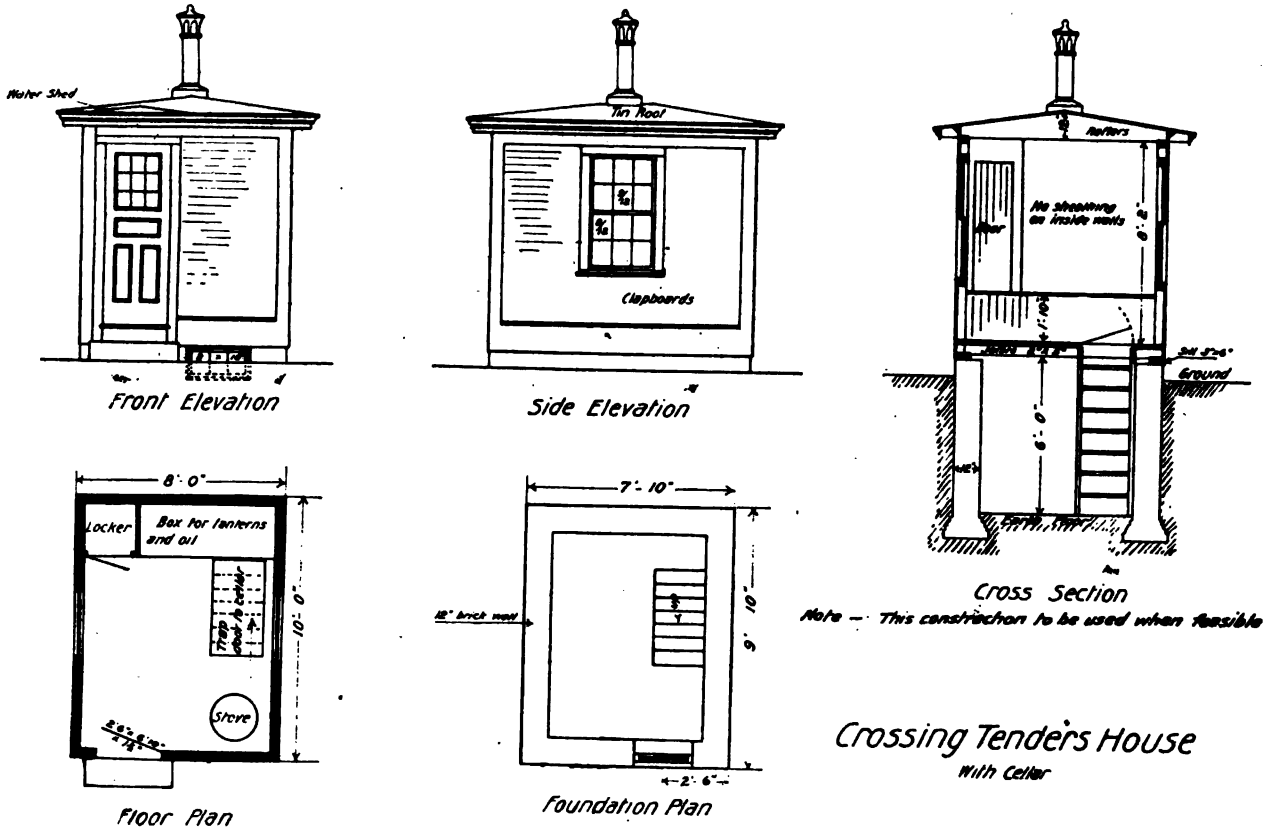

Water Shed
Front Elevation
Tin Roof
Clapboards
Side Elevation
Rafters
No sheathing on inside walls
Floor
6' 0"
10"
Soil 2'6" Ground
6' 0"
Cross Section
Note — This construction to be used when feasible
8' 0"
Locker
Box for lanterns and oil
Trap door to cellar
Stove
10' 0"
Floor Plan
7' 10"
18" brick wall
9' 10"
4—2' 6"
Foundation Plan
Crossing Tenders House
With Cellar
BOSTON AND MAINE R.R.

FIG. 82.

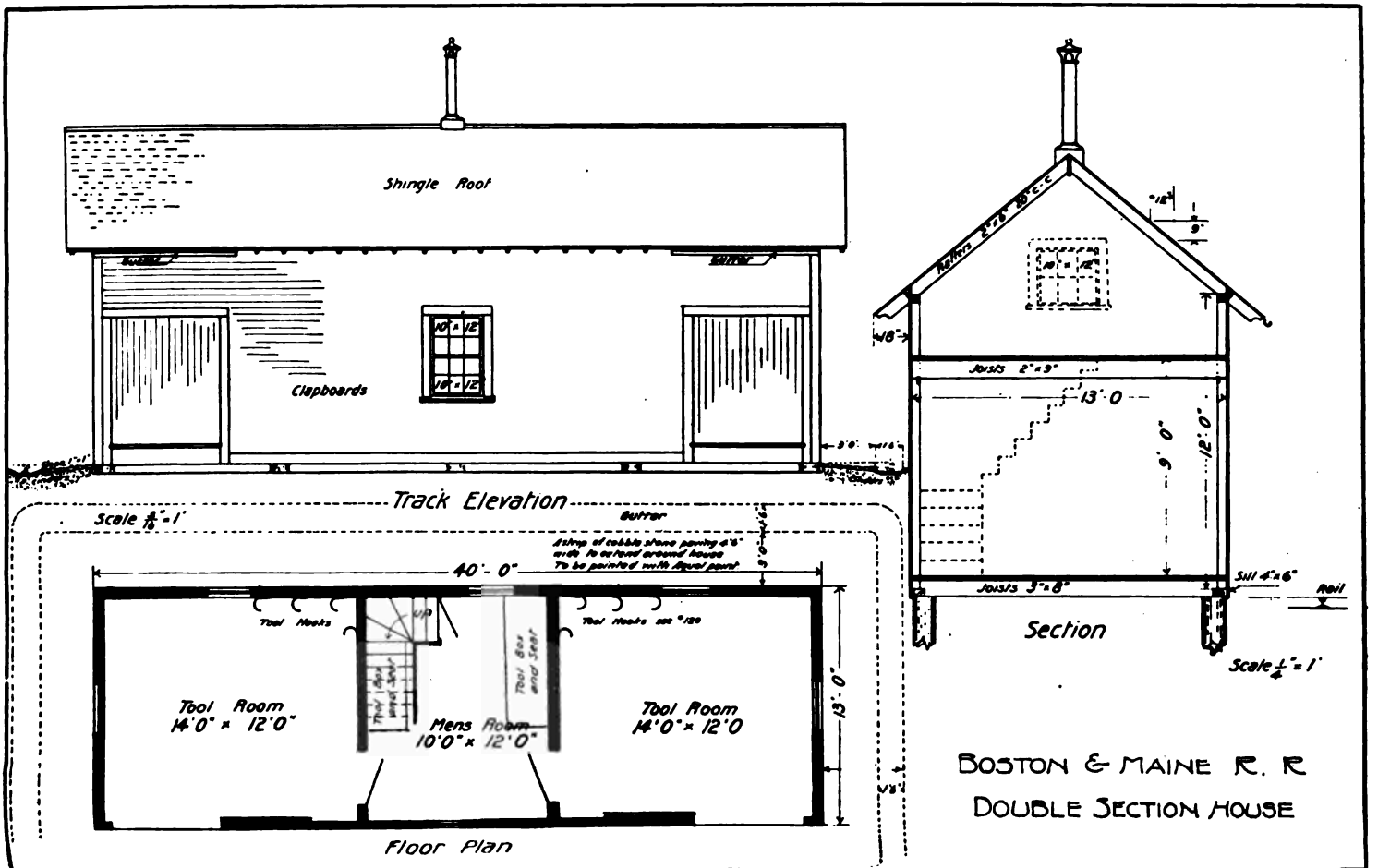


Fig. 111. Double Section House, B. & M. R. R.

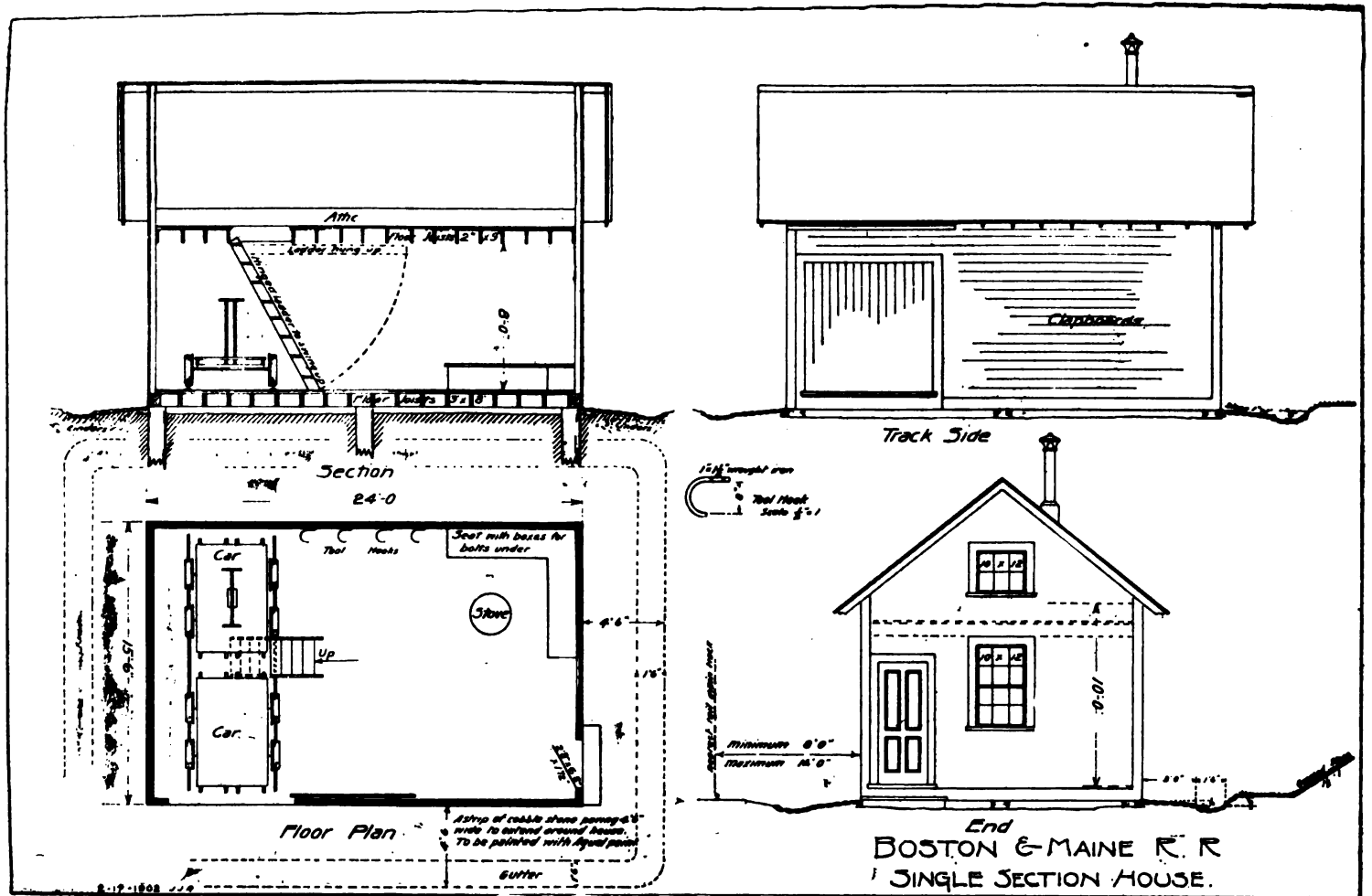


FIG. 34. Single Section House, B. & M. R. R.

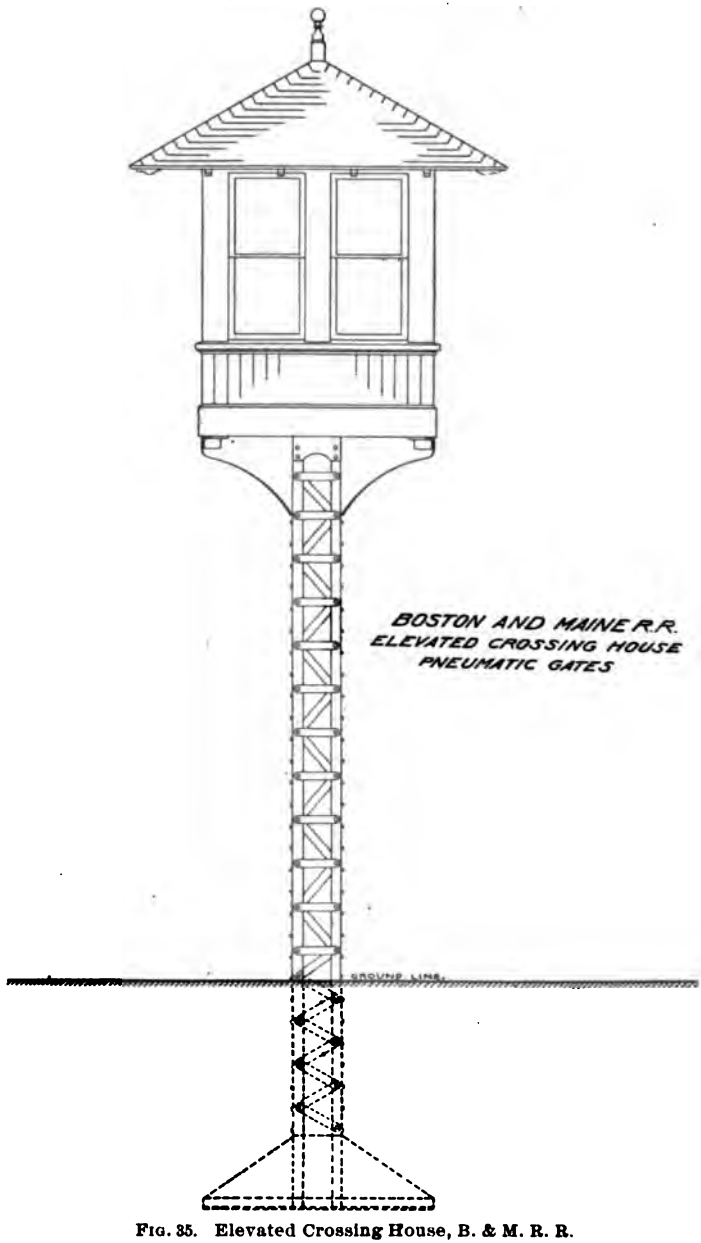
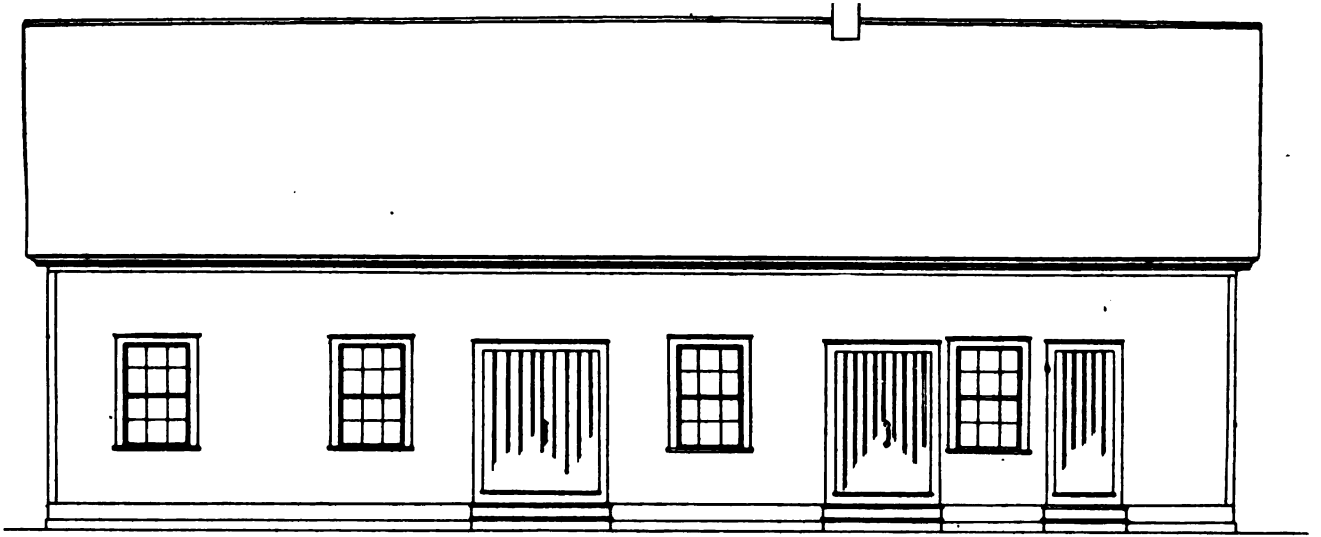


FIG. 35. Elevated Crossing House, B. & M. R. R.



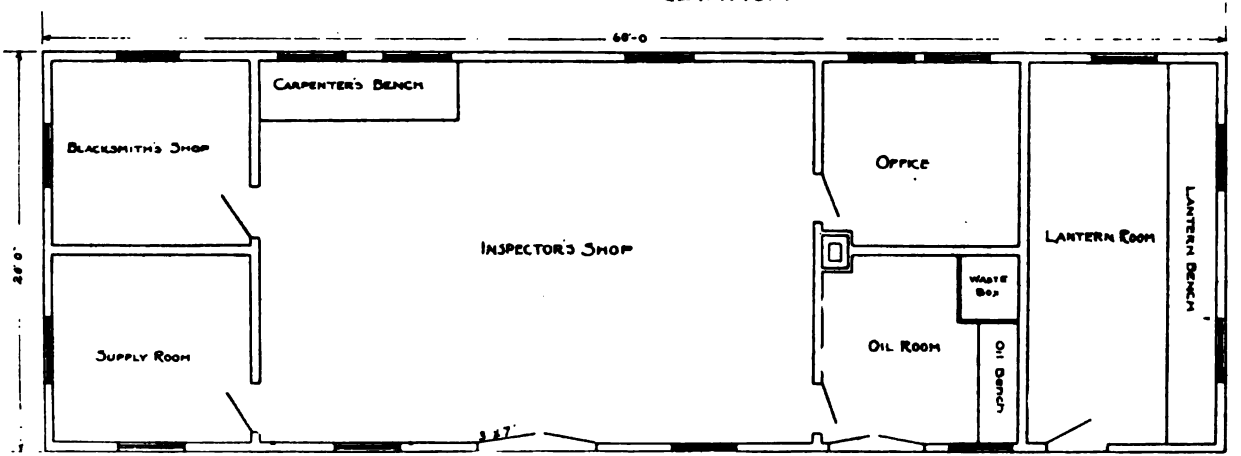


FIG. 36. Floor Plan, Inspector's Building, B. & M. R. R.

VII. Best Practical Sanitary Arrangements for Small Stations where there are no Water or Sewer Systems.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Gentlemen :—Your committee on subject No. 7, "Best practical sanitary arrangements for small stations where there are no water or sewer systems," beg leave to make the following report:

We had about sixty circulars mailed to as many members. We received answers from four, and I append their remarks to the report.

We regret very much that we did not receive more replies. The circulars were sent, mostly, among our Southern members, knowing that throughout the South the sanitary laws were very rigid, and for that reason we looked for some very valuable assistance from them.

As the report is now made (beside the four letters appended hereto) you have the experience of but one member.

The sanitary arrangement attached to the average railway station gets, in most cases, after once being set up, very little or no attention. It is very true that in some localities it is very discouraging even to look in, to say nothing about trying to keep it clean. It is likewise discouraging to the people who have an occasion to use these places when they find them not kept clean, and they will continue to make matters worse.

I can speak from some experience on this line. At a station of about 3,000 inhabitants we tried to keep the house locked by keeping the key hanging near the ticket window. This proved to be a failure wherever tried. The agent, discouraged at this, commenced the experiment of keeping it clean. After a time he was rewarded to a considerable extent and the persons using same had some respect for the place.

Along the line of the Toledo, Peoria & Western Railway, at stations varying in size from 300 to 2,000 inhabitants, we have five or six closets, the only connection to them being through the waiting room. They stand from 10 to 40 feet away from the depots, and are connected to it with two neatly built wings about 7 feet high, and about 4 feet apart. At these places we have had no trouble whatever in keeping them clean, as they are not accessible by the general public.

Air slaked lime is supposed to be on hand at these places at all times, and if there is any offensive odor from them, it is purely the fault of the station force.

The usual custom of moving the building from the old site to a new one is prohibitory in a great many places while in most cases it is the cheapest way out of the difficulty. Where moving is prohibited, I consider it cheaper to build large brick

vaults, and whenever necessary, have the contents burned out with acid.

It was our intention to solicit the practice of the health officers of more of the prominent Southern cities. After waiting for replies from our own members it was too late.

I append hereto a letter from the president of the board of health of Memphis, Tenn.

Yours very truly,

J. H. MARKLEY, *Chairman*,
F. J. LEAVITT,
G. J. PATTERSON,
E. B. ASHBEY,
T. J. DARRACOTT,
A. W. MERRICK.

INTERCOLONIAL RAILWAY.

MONCTON, N. B., May 20, 1903.

J. H. Markley, Esq., Chairman Committee:

DEAR SIR: I send you blue prints of our outside dry closets. We don't allow dry closets in stations where there is water pressure to flush with. We use up-to-date flush closets. Where no water, use outside dry closets, and cleanse with chloride of lime or ashes and dry lime, which is kept on hand at stations.

I send your sheet of questions marked, which I hope will suit your purpose.

Yours truly,

A. E. KILLAM, *General Inspector.*

SOUTHERN RAILWAY COMPANY.

PRINCETON, Ind., May 15, 1903.

Mr. J. H. Markley, Superintendent Bridges and Buildings, Toledo, Peoria & Western Railway, Peoria, Ill.:

MR. CHAIRMAN: I beg to submit the following remarks on subject No. 7, for discussion at our next annual convention at Quebec:

"Best practical sanitary arrangements for small stations where there are no water or sewer systems." I will say that the best arrangement that I have been able to make for water closets under such conditions is to dig a vault from 4 to 8 feet deep, and if the sub-soil is reasonably hard, I put a wooden curb for 18 inches or 2 feet below surface of ground, continuing it as high above ground as may suit general conditions, and set the closet on it, and before this vault gets nearly full, I dig another one and move the closet and fill up old vault. For curbing I usually use fairly good second-hand bridge ties or smaller timbers.

I.C.R.

PLAN OF TWO-STALL CLOSET

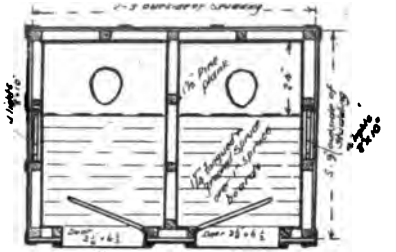
-AT-

WAVERLEY, N.S.

SCALE ¾" = 1'

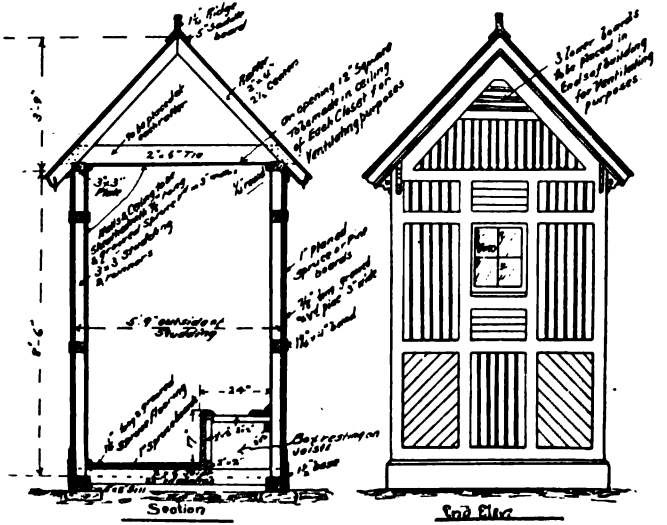
Chief Engineers Office
Moncton, N.B
May 15th 97.

(signed) P. Archibald
Chief Engineer



Plan

Note. Closets are provided with a box which, when full is removed through a small door in end of building, emptied and replaced



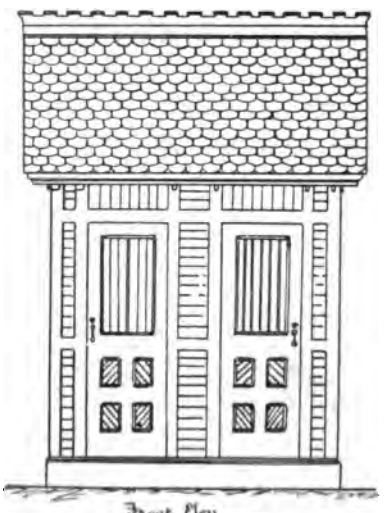


FIG. 87. Closets Intercolonial Ry.

There are, however, instances where a vault cannot be dug, and in such cases I set the closet up high enough to admit of drawers being inserted under the floor and from rear side, that can be removed and carted away and emptied and returned at small cost by scavangers, or a new set of drawers put in. In either case I find that a little lime or other disinfectant is very good. We keep one or two neatly painted water barrels and at least two pails at every station. The water barrels are kept filled with water, and from these the agent or other station employees can always get water for scrubbing purposes

Yours truly,

J. T. CARPENTER,
Superintendent Bridges and Buildings.

SOUTHERN RAILWAY COMPANY.

ATLANTA, GA., May 30, 1903.

Mr. J. H. Markley, Chairman Committee Best Sanitary Arrangements for Small Station, Peoria, Ill.

DEAR SIR: Referring to your circular of the 26th inst., this is a very important subject, and one that we are all very much interested in. I will answer the questions in the order propounded:

1. We are using brick walls around pits in dry places. We have none located in wet places.
2. We have never attempted any in very wet places, as the necessity has not arisen.
3. We do not have as much trouble in keeping them clean where they are connected to the building as we do where they are not connected, but I do not like them connected to the building, as they are very offensive if not carefully looked after, which is some times not done.
4. The only disinfectant used by us is common lime, and this is kept on hand in small quantities at the stations where it is to be used.

Yours truly,

J. L. LEMOND,
Roadmaster.

CHICAGO & EASTERN ILLINOIS RAILROAD COMPANY.

DANVILLE, ILL., July 6, 1903.

Mr. J. H. Markley, Peoria, Ill., Chairman of Subject No. 7, "Best Practical Sanitary Arrangements for Small Stations where there are no Water or Sewer Systems."

We have no sanitary system of this kind, only the old way, the using of vaults, boxes, or barrels for this purpose. We usually select dry places for location of buildings of this kind. Of course

where water accumulates during seasons of the year we overlook this part and allow the water to carry off the sewerage. We never connect these buildings with our depots, at all times putting them 50, 75, or 100 feet away from the building and on the same end of the depot as the freight house is, always using great care not to disturb our neighbors with these buildings.

Yours truly,

A. S. MARKLEY,

Superintendent Bridges and Buildings.

BOARD OF HEALTH, CITY OF MEMPHIS.

MEMPHIS, TENN., August 8, 1903.

Mr. J. H. Markley, Master of Bridges and Buildings, Peoria, Illinois.

DEAR SIR: Replying to yours of the 29th ult., will say, in reply to question first, that I think the best disinfectants you can use are chloride of lime or sulphate of iron (copperas). Of course there are more powerful disinfectants, but their cost renders them impracticable.

In reply to question second, there is no acid which will accomplish the work you desire, except those which are very expensive, and the amount necessary would make that method impracticable. I am utterly and strongly opposed to vaults. It is the most unsanitary method for so-called disposal of human excretions which can be adopted. Of course the matter is not really disposed of, but remains decomposing in the communities using this method. Where cremation is impracticable, I would suggest the use of the so-called "dry earth" system. This means the use of tubs, or boxes, which are removed at stated intervals, and while in use, the fecal matter should be covered once daily with lime or dry earth. I send you a copy of that section of our ordinance referring to the keeping of these boxes.

Yours truly,

HEBER JONES, *President.*

NOTICE.

Your attention is called to Section 258d of Health Ordinance, from which the following is taken:

That every house in the unsewered district shall be provided with a water tight box, with handles, having a capacity from three pecks to one bushel, let in under the privy seat, or a bucket or tub of such size and construction, as the Board of Health may prescribe * * * * *and "that at least once a day the excrement in the receptacle shall be covered with dry earth or dry ashes."* * * * *

During the summer months at least, this ordinance and especially the latter part in regard to the use of earth or ashes will hereafter be *rigidly* enforced. We suggest that each closet be provided at once with a receptacle for the dry earth or ashes, and a small shovel for using the same.

By order of the Board.

Attest: HEBER JONES, *President.*

MARCUS HAASE, *Secretary.*

DISCUSSION.

Mr. J. H. Markley.—I remember very well a year, or two years, ago our president stated that he had a good sanitary arrangement for a closet along his line and it was partly at my suggestion that this subject was continued over, with the prospects of getting some of his ideas in the report, but I would say that we did not hear from him in response to the circular which was sent out by the committee and consequently were unable to incorporate a description of his system in our report.

President.—I will say in reply to this, I am guilty. I did not answer the committee's circular for the very good reason that I presumed my general foreman had taken that matter up. He is, you know, a member of this Association and entirely familiar with the system. His letter came at the same time my own did, but I was extremely busy and could not answer just at that time, and I called his attention to the fact and suggested that he make a report for both of us for the system that was employed on our division, and I supposed he had done so until I received the report. We have, I think, solved the problem very well for our section of the country, for small stations, and while I hardly think it is best or appropriate for the president to make very extended remarks on this question, perhaps if you will permit me to do so, I will send a written description of our plan and the way that we have solved the problem to the secretary in time to incorporate in the proceedings.

Mr. B. F. Pickering (by letter).—I present a short description of one of our closets located at Center Ossipee. We made toilet rooms in one end of our station. The partition between the rooms is of North Carolina pine sheathing, double, and the seats on both sides back up to this, thus permitting us

to use a length of 30-inch culvert pipe for a vault which has a tight concrete bottom, concaved with the outlet pipe in center of bottom. The outlet pipe is ordinary 6-inch drain pipe with an ell on the vault end that comes flush with the bottom of vault and stopped by a simple drop valve hung on a hinge set in the concrete bottom and operated by a wire under the seat. This drain pipe runs to a cesspool located at a convenient distance from station. Vault is ventilated by an 8-inch air shaft running into an unused chimney in loft of station. For water supply we dug a well near and piped to a 2¾-inch Douglas force pump set in the corner of one of the toilet rooms, with the discharge piped into one side of the vault in such a manner as to impart a circular motion to the water as it is being pumped in, thus stirring up the contents and facilitating flushing. This makes a very satisfactory arrangement, and if the station men flush frequently in hot weather, is perfectly sweet. The cost was not excessive, but this will depend, of course, largely on depth of well and distance of cesspool. In this instance we had to dig a well only eight feet deep but were obliged to run 350 feet to find suitable location for cesspool.

Mr. Reid.—In some cases we have boxes which are more or less of a nuisance on account of the care that is necessary to be taken of them. At other points we just have the ordinary vault. We can get along with most anything at small stations.

Mr. Canty.—On the division where I am located we have a number of small stations equipped with ordinary vaults, which sometimes are very offensive. Many of them are located where there are no sewer or water systems. To eradicate the trouble, in some cases we dug wells near the stations, placed an oil barrel to store water in the attic, and installed a pump to lift water from well to storage barrel. Agent pumps barrel full of water as required. A pipe runs from this barrel down into an ordinary hopper closet, and the latter flushes into a cesspool, built at some distance from the station. This arrangement is quite cheap, simple, and appears to be satisfactory.

Mr. A. S. Markley.—I should like to ask Mr. Canty how he overcomes the trouble of the water freezing in the winter time.

Mr. Canty.—Simply by the heat from the station stoves. Doors leading into closets are kept partly open, and there is no trouble on account of freezing so far as I know.

President.—I noticed particularly, in my trip out to the convention at Minneapolis last year, that all through most of the West the water closets are not immediately attached to the stations, while all through the East the water closet is either in the building or attached to it as a general rule, and for the purpose of ventilation, for our own safety, as well as to avoid the public or health officers finding fault, we put in a ventilating pipe, which sometimes has been run into a chimney, or, in other cases, carried up through the roof to a sufficient height from the top of the building. This takes off the odor wonderfully. One would hardly believe the change that just that ventilating pipe will make.

Mr. Snow.—In putting up new stations we invariably put the closets inside the building, and in cases where we have to use dry closets, we put them in a corner of the building, but make them entirely separate by means of double partitions on the two sides adjacent to the main building. Where this double partition comes to the outside walls we leave open a gap in the boarding and finish it with louver slats. We use double doors between the closets and waiting-room, and if well ventilated through the roof with a good-sized flue and the vault is cleaned out properly, there is no trouble with them.

Mr. Reid.—At some of the small towns along our road, of say 200 population, our dry closets are built similar to what Mr. Snow speaks of, in one corner of the building. Access to the men's closet is from the outside, but access to the women's closet is from the inside of the waiting-room, through a vestibule, making two doors between the closet proper and the station. Then we also have the ventilating pipes that Mr. Pickering speaks of, made of boards that go up through the roof, and also use ventilators in the side, as Mr. Snow speaks of, and in that way these closets are very seldom offensive. I do not know of ever noticing anything that would be objectionable to them, although of course they are at very small towns, and I am not often near them.

Mr. Snow.—If not asking too much, I would like to ask Mr. Reid to send a little description, giving the plan of the closets used on his road, to the secretary, for the Proceedings.

Mr. Reid.—All right, I will try to do so.

Mr. Alexander.—I do not know that I have got the thing down fine enough to give you anything that would be adopted. We have a good many dry closets, but usually in an outer building at some distance from the station,—generally at the extreme length of the platform from the station, with a little walk to them. Those buildings are not offensive at a station, because they are far enough away, but they are offensive when you go into them, as a rule; but this, we find, is altogether due to the care of them.

Mr. A. S. Markley.—Mr. Chairman, since this matter came up it has occurred to me that we might in some cases change dry to wet closets at water stations by placing the closet over the drain from the stand pipe, as it would be flushed every time a train goes by that takes water, and sometimes that is pretty often.

Mr. Reid.—In regard to using the stand-pipe drain for flushing as stated, the number of trains taking water need not make any difference, as it could be flushed from the tank at any time, if necessary, by the station agent. That would be a very good arrangement without the trains taking water.

President.—Another idea for a vault under a water closet of that kind would be to simply have a drop valve that just drops over the regular outlet pipe; don't make any difference how much water accumulates, little or much, let it collect in there until your vault needs flushing, when the agent pulls the gate and lets it flush out. You will find a great advantage in that, and it is so simple that the agent cannot help operating it if he tries.

Mr. Reid.—If the agent is willing, he can keep it clean.

VIII.—Best Method of Making Annual Inspection of Bridges and Culverts, and Form of Report to be Made.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee issued a circular of inquiry on January 15, 1903 (see appendix), to which eighty-three replies were received, many of which contained very valuable information and indicated great zeal and interest on the part of the members to assist the committee in its work. The committee desires to express its appreciation and to thank all contributors for their valuable assistance.

The committee had nearly two hundred forms under review and data covering the inspection methods in use on sixty railroad systems of the country.

A preliminary draft of the report was prepared and fully discussed at a committee meeting held in Chicago during March, 1903, after which the following final report was prepared:

1. General.

While the title of the subject apparently limits the report to annual inspections of bridges and culverts, your committee believes that a separate discussion of annual inspections would not be as effective as a thorough review of all questions affecting bridge inspection and hence has decided to treat the subject from a more general and exhaustive standpoint.

The committee considers, however, that the report should be limited to the inspection methods employed by the regular bridge department and engineering officers in charge of the maintenance and improvement of existing bridges of an operated line of railroad and not to the inspection methods during manufacture and construction of new bridges.

2. Scope of Inspection by Bridge Department.

According to the organization and size of a railroad, the duties of the regular bridge department as far as inspection is concerned vary considerably. On some roads the bridge department inspects and reports on all classes of bridges, culverts, masonry, drains, buildings, etc., while on others the inspection is limited to bridges proper.

The answers received to the question as to whether culverts should be inspected by the bridge department, while varying in details and limited in some cases, indicate clearly that the general consensus is in favor of the larger size culverts being inspected by the bridge department.

The answers to the question as to whether the bridge department should inspect and report on the masonry and foundation of bridges indicate that the best practice would seem to be for

the masonry and foundations to be considered as part of the bridge and hence falling within the sphere of the bridge department to report on.

The opinions in regard to the extent to which the track department should be relied on for the current inspection of bridges, masonry, and culverts, indicate that the general opinion would seem to be that the regular trackmen, on account of their being daily in the vicinity of such structures, should watch all bridges, masonry, and foundations in a general way, more particularly with reference to the waterway being kept clear and possible damage during high water, reporting promptly any defects they may note and taking such necessary steps as the emergency may require.

3. Classification of Inspections.

Bridge inspections can be grouped in two classes, one in which the inspection is made by the division officials only, the other where a general railroad officer or a representative of such general railroad officer is present. This distinction applies practically to a railroad operating either under a division system or a department system.

The first class of inspection can be called "Current Inspection," its purpose being to keep the structure in safe condition, to promptly discover any defects, and to report same promptly so that repairs can be made before the safety of the structure is affected. In other words, current inspection embraces the inspection necessary to keep the structure at all times in a safe condition. This inspection furnishes to the division men in direct charge of the structure the necessary information to serve for their guidance in outlining the work to be done by the regular bridge maintenance forces. The inspection is made by a regular division bridge inspector, by a mechanic detailed from the bridge gang, by the bridge foreman, master carpenter or supervisor of bridges and buildings, right along at all times, or periodically on special monthly, bi-monthly, or quarterly trips.

The second class of inspection can be called "General Inspection," frequently called the annual inspection, although in many cases conducted semi-annually, or even quarterly. This class of inspection has for its object not only to check the work of the division organization, but also to make a more careful investigation of important bridges, to make suitable record of the general condition of all bridges and structures on the entire road, and further to ascertain and settle what extensive special repair or renewal work should be done in the following working season.

The general inspection is usually made by a representative of the chief engineer or engineer maintenance of way, such as the bridge engineer, general bridge inspector or assistant engineer, who passes over each division of the road in connection with the division men and makes a general inspection of all structures on the road.

In addition to current inspection and general inspection, there is a class of bridge inspection that might be designated "Special Inspection," where, owing to the magnitude and importance of the bridge, special bridge experts or consulting engineers are called in, or in case of the condition of a bridge being reported as doubtful a special inspection of same is ordered.

4. Bridge Inspection Systems.

A valuable tabulation is presented in the appendix, compiled by Mr. I. O. Walker, member of the committee and Mr. Job Tuthill of the Pere Marquette R. R., as to the various methods of bridge inspection in use on various railroads of the country.

The principal answers received to the inquiries as to the methods in use for conducting bridge inspections on railroads are compiled in the appendix.

At the first glance, the data presented are confusing and apparently not indicative of much chance for clear deductions being drawn from the existing practice of railroads. After more careful study, however, and after making allowance for variations in the systems reported due to local conditions, special organizations, the varying size of roads and the density of their bridges and structures, certain general guiding principles underlying the general practice can be evolved and formulated.

a. *Current Inspection:* In regard to current inspection the fundamental principle is that all bridges and structures should be visited periodically by a competent bridge man, not necessarily an engineer, who examines all important parts, notes and reports the general condition and whether there are any defects requiring immediate attention or repairs during the current working season.

The division engineer or superintendent of bridges and buildings, in other words, whoever has general charge of bridge maintenance on the division or district, should watch these reports and act promptly on receipt of same, according to the emergency. He will necessarily, in important cases, make a personal supplementary examination and must keep himself advised at all times of the general condition of all bridges and structures under his control by frequent inspection trips over his territory.

For the information of the higher officers, both so as to keep them advised of the condition of the bridges and also what work is being done in the way of maintaining them, your committee considers it desirable that the division engineer or superintendent of bridges and buildings should make out a monthly inspection report, noting briefly the bridges inspected during the month and stating the general condition, any defects found or repairs required, and action taken or recommendation. This report should be simple and prepared for information and record purposes.

b. *General Inspection:* The guiding principle and purpose of a general inspection is to have same made by or under the direction of an expert bridge engineer, representing the chief engineer or other officer in general charge of bridges.

This general inspection, made annually, semi-annually, or quarterly (and on some railroads constantly by a regular general bridge inspector reporting to the chief engineer or other officer in general charge of bridges) serves not only to check up the work of each division but also makes a comparison between the various divisions possible and promotes uniformity in the standard of maintenance and methods. It should also determine what structures should receive extensive repairs or be renewed or replaced in the following working season. It serves further as a check on the general office bridge records, recording changes made in the existing structures, etc.

The general inspection is of such importance that the inspection notes should be thorough and should be embodied on a complete and full inspection report, going into much greater detail than in the routine current inspection.

5. Rules and Regulations for Bridge Inspection.

Your committee has considered the desirability of formulating a standard code or rules and regulations for bridge inspection, but has come to the conclusion that the different conditions and organizations on the various railroads preclude any one standard being applicable to all.

6. Methods for Passing Inspectors Over Road.

The various methods employed for passing inspectors or inspecting parties over the road are shown in the appendix from the answers received to this inquiry. In general the best practice can be outlined as follows:

For current inspection on roads with comparatively few bridges and light traffic, the inspector works his way over the road on a light hand propelled three-wheel velocipede. On roads with many bridges close together, the inspector can cover the territory on foot with occasional rides on passing trains or engines. On roads with dense traffic, especially in the eastern sections of the country, it is not considered good practice to allow promiscuous use of velocipedes and the inspector is obliged to work the various sections on foot with such assistance as he can obtain from trains and engines.

Where the inspection is made by the division engineer or superintendent of bridges and buildings, usually accompanied by the bridge foreman, bridge inspector, and sometimes by an extra bridgeman, a gasoline four-wheel inspection car offers the best method of getting over the road, provided the traffic is not so dense as to make this dangerous.

For general inspection trips, a special inspection engine or train is usually provided. On some roads, where the towns

are widely separated or hotel accommodations not desirable, this train is provided with commissary and sleeping quarters.

7. Bridge Inspector's Tools.

It is customary to prescribe certain tools and articles that a regular bridge inspector should always have with him, such as follows: Inspector's hammer, brace and bit or auger, testing bar, small axe, tape line, rule, callipers, and marking crayon.

8. Bridge Inspection Reports.

There are numerous existing bridge inspection systems and report forms which have proved very serviceable under the special conditions and organization of road where used but which could not be considered as sufficiently elastic for all conditions. In fact, your committee finds that the greatest difficulty it is confronted with is the attempt to outline one system for all conditions and roads.

The committee presents the following outline of a system of bridge inspection reports as one that is applicable to general average conditions:

a. *Current Inspection Reports for Maintenance:* The current bridge inspection is made by a regular division bridge inspector (on some roads called "bridge walker") or by the master carpenter, foreman of bridges, or gang foreman. The purpose of this inspection is to examine the condition of the bridge and to determine any repairs required either in the near future or emergency repairs calling for immediate action. In all cases a record should be made while at the bridge of the conditions found and date of inspection.

There are several good forms in use for reporting the current inspection, as above explained, but the committee presents the following suggestions as offering noteworthy features, especially on account of the elasticity and adaptability of the forms to varying conditions and hence suitable for general recommendation and adoption.

A system much used is for the field record to be kept in a blank book and the notes are subsequently compiled and reported in condensed form.

Another system is to have special forms. The committee presents two recommended forms: Form "A," "Current Bridge Inspection Report," and form "B," "Summary Current Bridge Inspection Report."

Form "A," or the "Current Bridge Inspection Report," to be issued as a separate sheet, size 5½x8 inches, or a book 5½x 8½ inches, if desired to have it bound in book form. The horizontal ruling, if used, should be spaced ¼ inch. The blank is simple and allows the inspector in filling it out to use his own phraseology, and thus makes it elastic and adaptable to all classes of bridges, track openings, and structures for which such reports are prescribed. The blank can be either in pad form or book form. The inspector would either write out

Recommended Form "A" Size 5½"×8"

Form M. W. Report No.

A. B. & C. R. R. Division

CURRENT BRIDGE INSPECTION REPORT

I have to-day inspected

at

and find its condition as follows:

The following work is required to maintain structure in good condition:

The following work must be done to keep the structure safe:

Date,..... ..190 .....
Inspector

NOTE — Make separate report for each bridge or structure inspected. Send report daily to the .....of the Division. Report by telegraph to the.....and the Superintendent of the Division all serious defects that require immediate attention.
In case the condition of the structure is dangerous, flag all trains and telegraph the Division Superintendent

FIG. 88. Form of Bridge Inspection Report Blank, A. B. & C. R. R.

Recommended Form "B" Size 8" × 13"

Form M W

A. B. & C. R. R. ..... Division

SUMMARY CURRENT BRIDGE INSPECTION REPORT

For 190

Bridge No or Structure	Kind of Structure	Day of Month Inspected	Condition	Action Taken or Recommendation

Date ..... 190 .....

NOTE — This report to include all bridges and structures inspected during the period covered by the report.

FIG. 89. Form of Bridge Inspection Report Blank, A. B. & C. R. R.

a copy for his record or use carbon paper and retain the duplicate. Instructions to bridge inspectors are issued by circulars or printed in each book. The inspector notes on the report any material needed for necessary repairs and also furnishes a sketch and dimensions of any special parts required. This form can be readily adapted and its size changed so as to be used in book form with a stub for the bridge inspector's record. The committee presents this blank as a separate small sheet, leaving it to individual preferences to issue it in book form, with or without stub, but expresses the opinion that the small sheets in pad form are preferable.

The purpose of form "A" is to force the inspector, whoever he may be, to record the fact that the bridge had been visited on a certain day and an inspection made and serves as a record and also advice to his superior.

Form "B," or the "Summary Current Inspection Report," to be issued as a separate sheet, 8x13 inches. The horizontal ruling should be ¼ inch. In case the reports are to be typewritten, horizontal ruling should be omitted. Where this report is to be used in field for recording the inspection while on the ground, it can be issued in book form and the size of the sheet reduced or made to cover two pages facing each other. The committee presents this blank as a separate sheet, leaving it to each railroad to issue same in modified shape in book form, provided it is to be used in the field. In case, however, the system of "Current Bridge Inspection Reports" is adopted and used for the field current inspection, then this "Summary Current Bridge Inspection Report" becomes an office blank and hence should be properly in sheet form.

The purpose of this form "B," when used only as an office form, is to summarize the daily or trip inspections during the month and make a condensed record of same. If used as the original field record it would be the only blank required for current inspection.

In the opinion of the committee, these two forms, either "A" and "B" combined, or using "B" only, offer a general and elastic system for the regular routine "Current Inspection," serving mainly to keep the bridges safe as far as ordinary maintenance by the division forces is concerned and at the same time enabling the superior officers to be advised of what is being done and recording all inspections or visits to bridges by parties responsible for the current maintenance work.

b. *General Bridge Inspection Reports for General Inspectors:*—As indicated above, the purpose for which a general inspection is made is of such importance as to warrant a more complete inspection report than absolutely necessary for current inspections.

A great many roads of the country have very elaborate and detail inspection reports for this purpose, some in sheets as large as four square feet in size, others in sheets of usual legal

cap size, others in small or large book form, others in large books or sheets one half of each sheet being virtually a copy of the "Bridge Record Book," and finally the method of using individual blank books for field memoranda (using the "Bridge Record Book" or blue prints of the "Office Bridge Records" for reference as to information about the bridges) and subsequently in the office compiling the information on large inspection reports.

Most of the forms specify in detail, by vertical column or side headings, the various items to be investigated at each bridge, in some cases as high as fifty items. While on particular roads and under certain organization systems this method of minute detail in the inspection reports may be working successfully, the committee does not believe that, in selecting a blank as adapted for general use by all railroads of the country, it should lose sight of the fact that there are many railroads that would not approve this great detail nor would they have the organization which would enable it to be carried through. To fill out these blanks conscientiously while on the ground would make the inspection cover too much time and there are roads reporting such blanks as nominally standard but yet the system is not rigidly carried out from year to year.

It is impossible to prescribe in one form headings and items to be examined which are all adapted to all classes of bridges, trestles, waterways, track openings, highway bridges, etc., and hence in practice only part of the items can be filled in for any particular structure and frequently special items have to be added for which usually too little space is allowed. It would seem preferable to issue instructions and rules for inspecting the various classes of structures and leave it to the inspector to apply these rules in each particular case, mentioning in the report the general condition and noting specially where defects are found.

For the reasons indicated, especially also as the committee's endorsement of a blank should be such as to allow of its adoption generally, the committee believes that the general inspection report should be simple and elastic, so as to accommodate itself to any class of organization on a road and be adapted to the various classes of structures to be inspected without having on the one hand to omit filling out many of the columns or on the other hand having to add numerous items. In other words, the form should be more general, leaving it to the inspecting engineer to fill it out to such extent as thought desirable. Further, it should not be necessary to transcribe from the "Bridge Record Book" complete data as to the physical characteristics of the structure, as the transcribing of this data is unnecessary if the inspecting engineer has a copy of the bridge record with him for reference. It is desirable, however, for ready reference, especially of the higher officers who are not familiar with the various types of structures, to note briefly the

principal characteristics, such as kind of bridge, length, age, and any pertinent reference to previous reconstruction or recent work done. The main feature in such a form is not to have it circumscribed by too much specialization and minutiæ in the column or side headings, but to leave ample space and opportunity to vary the wording of the record in accord with the various conditions and classes of structures to be embraced in the one report. Such a report will allow all classes of memoranda to be made according to the exact scope and special purpose for which it is made.

The committee recommends the adoption of form "C" to be known as "General Bridge Inspection Report," to be issued in book form and in separate sheets. In book form for field use, each page would be 5½ x 8 inches with sheets, 11 x 8 inches, folded in the middle, making a book 6 x 8½ inches. The separate sheets for office use and summary reports, should be exactly the same as used in book, viz.: 11 inches wide and 8 inches high, printed on one side only. If desired, however, special blanks of larger size for office use could be printed. The horizontal ruling should be ¼ inch. The separate sheets for office summary reports should be left without horizontal ruling if typewriter is to be used.

9. Typical Forms for Bridge Inspection Reports.

Recommended Form "A."—A report form similar to this form is in use by the Lehigh Valley Railroad. The Ohio River Railroad has a very similar small one-page letter head size report turned in daily by the "bridge walker."

Recommended Form "B."—A report form similar to this form is in use by the Lehigh Valley Railroad, Wabash Railroad, and Lake Erie & Western Railroad. The Norfolk and Western Railway and the Rutland Railroad use a similar form for reporting inspection of culverts, pipes, pit cattle-guards, etc. The Oregon Short Line Railroad, Union Pacific Railroad, and Chicago & North Western Railway use a similar form for compiling, from the field inspection book, a statement of bridges requiring renewal or repairs.

Recommended Form "C."—A report similar to this form is in use in book form by the Great Northern Railway, Atchison, Topeka & Santa Fe Railway, and Norfolk & Western Railway.

The Norfolk & Western has, in addition, a separate large office form in separate sheets with similar headings and bridge data printed on left side, the inspection results and recommendations being filled in on right-hand side.

The Louisville & Nashville Railroad uses a large inspection report with bridge data printed on left side and wide blank columns for inspection report.

The Nashville, Chattanooga & St. Louis Railway uses a similar small book form for field inspections, the bridge data being

Form "C" Size 11"×8"

.....Division

From.....To.....

GENERAL BRIDGE INSPECTION REPORT

For.....

Inspected by 190

Bridge No. or Structure	Location	Kind of Structure	Bridge Data	Date Inspected	General Condition, Description of work required, Recommendations

FIG. 40. General Bridge Inspection Report Blank, A. B. & C. R. R.

entered on left page and the inspection notes on the blank right page, excepting the right page is divided into four sections to allow the notes of four separate inspections to be entered before having to take a new book.

The Intercolonial Railway uses a similar form, issued in large single sheets, 18 x 14 inches, on the left side of which are 18 vertical columns for bridge data (practically bridge record sheet) and the balance of sheet for date of inspection and remarks under which the condition is entered.

All typewritten bridge inspection reports without using a special form and the use of blank field books can be, in a general way, classed as belonging to type "C." While no special form is used, the method is the same, viz., to record name and leading characteristics of bridge and then follow with notes as to condition of bridge, materials required, recommendations, etc., without attempting to group the notes in columns.

In addition, the committee presents for the information of the association the following forms, as illustrating typical forms not covered in the recommended forms "A," "B," and "C."

Typical form "D," Pere Marquette Railroad, Bridge Inspection Report, representative of type of individual sheet for each bridge inspected, with detail enumeration of items to be examined. The Boston & Maine Railroad uses a similar small report in book with stub. The Central Vermont Railway uses an individual report for each bridge on a large sheet, with a small number of side headings. The Southern Railway uses a single sheet for each bridge, folded, double letter paper size, enumerating 48 items to be answered.

Typical form "E," Canadian Pacific Railway, Bridge Inspection Report, representative of type of reports with a large number of detail items enumerated in side headings, and with a number of vertical columns for various bridges, and then on the right, additional data as to any special item of any particular bridge. This blank is issued in book form for field use, 5½x 9¾ inches, and in sheets, 8½x14 inches, for office use. Similar blanks are in use in sheet form on the Wisconsin Central Railway. The Chicago & Northwestern Railway uses practically the same forms, issued in book form, 4¼x10 inches, for field use, and in separate sheets, 8½x13½ inches, for office use. The Duluth, South Shore & Atlantic Railway uses a similar book form, 4¼x9¾ inches. The Northern Pacific Railway uses a similar book, 5¼x9¾ inches, and office sheets, 8½x14 inches. The Chicago & Northwestern Railway uses practically the same forms, issued in book form, 4¼x10 inches, for field use, and in separate sheets, 8½x13½ inches, for office use, excepting the two columns bridge number and item are omitted. The bridge number and item number have to be written by hand in the remarks column.

The Oregon Short Line Railroad and the Union Pacific Railroad use a similar book form, about 4¼x9¾ inches, excepting

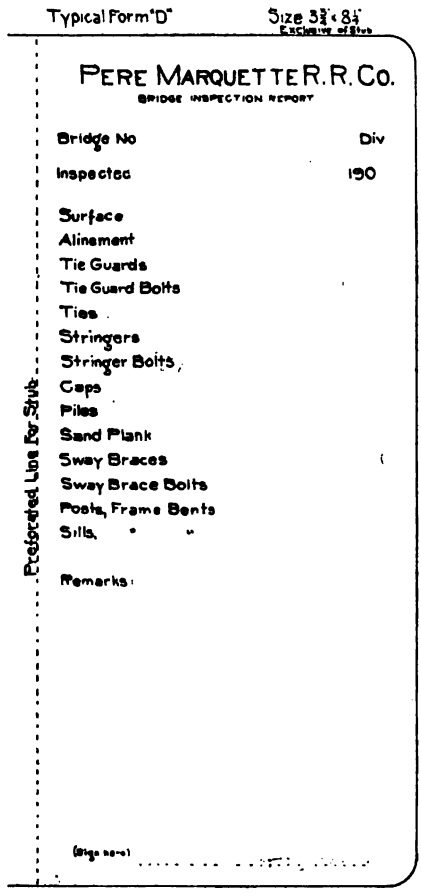
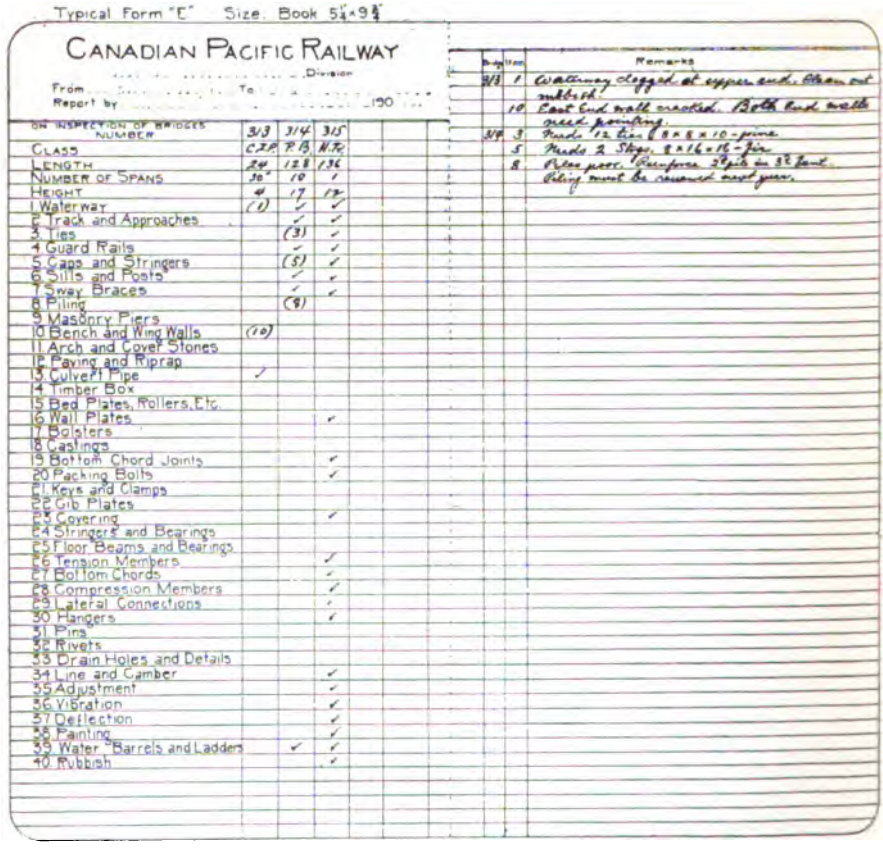


FIG. 41. Bridge Inspection Report Blank, P. M. R. R.



Typical Form "E" Size. Book 5¼×9¾

CANADIAN PACIFIC RAILWAY

Division

From ... To ...

Report by ... 190 ...

ON INSPECTION OF BRIDGES NUMBER	3/3	3/4	3/5
CLASS	C.P.	P.B.	N.T.
LENGTH	24'	128'	136'
NUMBER OF SPANS	30"	10	1
HEIGHT	4'	17'	17'
1 Waterway	(1)	✓	✓
2 Track and Approaches		✓	✓
3 Ties		(3)	✓
4 Guard Rails		✓	✓
5 Caps and Stringers		(5)	✓
6 Sills and Posts		✓	✓
7 Sway Braces		✓	✓
8 Piling		(8)	
9 Masonry Piers			
10 Bench and Wing Walls	(10)		
11 Arch and Cover Stones			
12 Paving and Riprap			
13 Culvert Pipe	✓		
14 Timber Box			
15 Bed Plates, Rollers, Etc.			
16 Wall Plates			✓
17 Bolsters			
18 Caslings			
19 Bottom Chord Joints			✓
20 Packing Bolts			✓
21 Keys and Clamps			
22 Gib Plates			
23 Covering			✓
24 Stringers and Bearings			
25 Floor Beams and Bearings			
26 Tension Members			✓
27 Bottom Chords			✓
28 Compression Members			✓
29 Lateral Connections			✓
30 Hangers			✓
31 Pins			
32 Rivets			
33 Drain Holes and Details			
34 Line and Camber			✓
35 Adjustment			✓
36 Vibration			✓
37 Deflection			✓
38 Painting			✓
39 Water Barrels and Ladders		✓	✓
40 Rubbish			✓

Bridge		Remarks
3/3	1	Waterway clogged at upper end. Clean out ballast.
	10	East end wall cracked. Both end walls need pointing.
3/4	3	Needs 12 Lin. ft. 8×8×10-piles.
	5	Needs 2 Stgs. 8×16×16-ft.
	8	Piles poor. Pumpkins 28 pile to 32 feet. Piling must be renewed next year.

Fig. 42. Bridge Inspection Report Blank, C. P. Ry.

Typical Form "F" Size 17"×14"

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SOUTHERN PACIFIC COMPANY MAINTENANCE-OF-WAY DEPARTMENT

Condition of Bridges, Viaducts, and Trestles on . . . . . Division . . . . . Railroad 190

Number	Kind of Bridge	Name of Stream or Cañon	Foundation		Bed Plates and Pedestals	Rollers and Frames	Trusses					Girder	Laterals		Floor System			Rivets	Hangers	Castings	Paint	Action Under Trains	Length of Structure Requiring Renewal Next Quarter	Date of Inspection	Remarks and Recommendations
			Masonry Piers	Wooden Piers or Bents			Upper Chord	Lower Chord	Posts and Bars	Rods and Braces	Counter Braces		Upper	Lower	Floor Beams	Stringers	Ties and Guard Timbers								

FIG. 43. Bridge Inspection Report Blank, So. Pacific Co.

Typical Form "G" Size 13¾ × 8½

Form 672

New York Chicago & St. Louis R. R. Co.

Maintenance of Way — Bridge Inspection

Bridges Nos. 21 to 33

Bridge Number	Date 190	Number of Bent	Class	Piles 1	2	3	4	Foundation Class	Foundation Condition	Class	Sill and Intermediate Cap	Posts 1	2	3	4	Cap	Stringers 1	2	3	4	5	6	Ties	Guard Rail	Sway Braces	Longitudinal Braces	Iron	Condition of Fire Protection
21	Dec 3							Gravel	O.K.	Steel													O.K.	O.K.			1-50 ft. Plate Girder span	O.K.
"	" "							"	"	Iron													O.K.				1-27 ft. through Iron Girder	"
24	" "		Pile		O.K.			Piles									O.K.	O.K.	O.K.	O.K.			O.K.	O.K.	O.K.	O.K.		O.K.
25	" "	1						Bank		Iron	6	6	6	6	X	6	D.	6	6	D.	6	6	S	S.	6	6		O.K.
26	" "							Piles	O.K.	Iron	O.K.	O.K.	O.K.	O.K.		O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.		O.K.	O.K.	O.K.		O.K.
32	" "							Stone	Piers cracking	Iron							O.K.	O.K.	O.K.	O.K.			O.K.	O.K.			One Wind Brace new required	
"	" "							Piles	O.K.	Iron	O.K.	O.K.	O.K.	O.K.		O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.		O.K.
33	Dec 1	3						Bank		Iron	S.	S	S	S	S	S	6	6	6	6	6	6	S	S	S	S		O.K.

SYMBOLS
- OK Good for more than one year
- D Dangerous must be removed at once
- 6 Must be removed within 6 months
- S Must be removed within one year
- X Replaced since last report.

I hereby certify that I personally made the above examinations on dates named and that this report is correct in every particular.

.....
Inspector

Form 66 Bridge Inspection Report, N. Y. C. & St. L. R. R. Co.

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the blank page for remarks is ruled and columns provided for reporting in detail the condition of piles, caps, etc., of trestles.

Typical form "F," Southern Pacific Railway, Report of Bridge Inspection, representative of type of large bridge report sheets, with a large number of detail items enumerated and grouped in vertical columns. The Galveston, Harrisburg & San Antonio Railway uses a similar report. This sample is typical of similar reports in use on the New York Central Railroad; Pennsylvania Lines West of Pittsburgh; Toledo, St. Louis & Western Railroad; Buffalo, Rochester & Pittsburg Railroad; Cincinnati, New Orleans & Texas Pacific Railway; Rutland Railroad; and Algoma Central & Hudson Bay Railway.

Typical form "G," New York, Chicago & St. Louis Railroad, Bridge Inspection for Trestles. The Southern Pacific Company uses a similar report in small sheets in pad form. The Toledo, St. Louis & Western Railroad uses a similar sheet report for trestles, 11x8½ inches.

10. Conclusions:

There should be a clear distinction made between "Current Inspection" and "General Inspection."

The purpose of the current inspection is to keep the structure in safe condition, to promptly discover any defects, and to report same promptly so that repairs can be made before the safety of the structure is affected. It is important that a simple record should be made while at the bridge and the superior officer kept advised of all such inspections promptly, whether made by a bridge mechanic, gang foreman, or division bridge inspector.

The purpose of the general inspection, frequently called the annual inspection, although in many cases conducted semi-annually, or even quarterly, is not only to check the maintenance work of the division organization, but to make a more careful investigation of important bridges, to make suitable record of the general condition of all bridges and structures on the entire road, and further to ascertain and settle what extensive special repair or renewal work should be done in the following working season.

The current inspection should not be done in a haphazard or intermittent manner, but should devolve on one or more experienced and trained bridgemen whose duty it should be to follow up the current bridge inspection along a certain prescribed programme which would vary according to the local conditions on each road. The division engineer or superintendent of bridges and buildings or who ever has general charge of bridge maintenance on the division or district, should watch the current bridge inspection reports and act promptly on receipt of same, according to the emergency. He will necessarily, in important cases, make a personal supplementary examination and must keep himself advised at all times of the general

condition of all bridges and structures under his control by frequent inspection trips over his territory.

For recording the current inspection, the committee desires to emphasize that there are many good and valuable systems and forms in use adapted to special conditions on many railroads, but believes its recommendations should cover only forms which are elastic and adapted for general conditions.

The committee recommends for recording the current inspection either a blank book, supplemented by typewritten reports, or the forms "A" and "B" presented with this report and known as the "Current Bridge Inspection Report" and the "Summary Current Bridge Inspection Report."

For use of the general inspection the committee recommends the form "C," presented herewith and known as the "General Bridge Inspection Report."

Your committee further recommends that the regular bridge department should be responsible for and hence should inspect and report on all bridges, culverts, masonry, and foundations, without placing direct responsibility on the track department. This, however, should not exclude the track department from watching all such structures in a general way and the obligation to report promptly any unusual signs of defects or trouble, and to take such necessary steps as the emergency may require, more particularly in connection with the waterway opening, condition immediately after high water, burnouts, damage done by accidents or casualties of any kind, etc. The track department should be responsible, however, for keeping waterways clear, bridge seats clean, extinguishing fires, keeping small drains open, and the track in proper shape at the runoff at each end of a bridge and on the bridge, using when necessary temporary shims on the bridge ties.

WALTER G. BERG, *Chairman*,
J. A. DODSON,
C. F. LOWETH,
ARTHUR MONTZHEIMER,
A. ZIMMERMAN,
A. SHANE,
I. O. WALKER,
Committee.

APPENDIX TO REPORT OF COMMITTEE ON "BEST METHOD OF MAKING ANNUAL INSPECTION OF BRIDGES AND CULVERTS, AND FORM OF REPORT TO BE MADE."

EXTRACT FROM CIRCULAR OF INQUIRY, ISSUED JANUARY 15, 1903.

Information is desired on the following points relating to inspection of bridges on operated sections of a railroad, not to inspection during manufacture or construction:

1. What is your system for current inspection of bridges, how frequently made, by whom, and specimen of report blanks?

2. Do you keep a regular bridge inspector for the current inspection of bridges?

3. What is your system for quarterly, semi-annual, or annual inspections, by whom made, specimen of report blanks, to whom are these reports sent, what use is made of same, and in whose office ultimately filed?

4. Is there any other special class of bridge inspection that you use or recommend?

5. What are the principal points examined in each class of inspection?

6. How is the inspection made, how does the inspector get over the road, what tools does he employ, etc.?

7. To what extent do you depend on the track department for current inspection of bridges and culverts?

8. Should culverts be inspected by the bridge department?

9. What is your minimum limit of an opening in the road-bed so as to be classed as a "bridge?"

10. To what extent should the masonry and foundations of bridges be inspected by the bridge department?

11. Brief outline of the organization of the bridge department on your road.

EXTRACTS FROM ANSWERS RECEIVED BY THE COMMITTEE TO CIRCULAR OF INQUIRY.

Wm. Ashton, Resident Engineer, Oregon Short Line Railroad:

1. The engineering department makes an annual inspection of all bridges and culverts and other waterways and conduits. This inspection is made by the division engineer, whose duties are similar to those of maintenance of way engineer on some lines, and the superintendent of bridges and buildings. When practicable the roadmaster of each district accompanies the division engineer and superintendent of bridges and buildings over his district. This party is filled out by taking the bridge foreman for each district, and one or two men, as the nature of the work may require, for doing proper inspection work.

The annual bridge inspection is made during the months of September and October, and this inspection is made not only for the purpose of determining the condition of the bridges, but also for the purpose of obtaining data of the material required for bridge renew-

als and repairs for the coming year, as well as for the preparation of a schedule showing the work in detail to be done on each bridge or culvert for the coming year. On this schedule, estimates for material, as well as the cost of new bridges and bridge repairs for the coming year, are made up.

The annual inspection made during the months of September and October is the only regular inspection made under the direction of the engineering department. In addition to this, however, a special inspection is made yearly, under the direction of the division engineer, of all steel or iron trusses or viaducts. This inspection is made in detail, being a careful examination by competent men of all parts of the steel structure, with view to determining any loose rivets, loose nuts, unusual deflections, or other weaknesses or deficiencies of our steel bridges.

The reports made by the division engineer from his annual inspection are sent to the head of the engineering department, as well as all reports made on special inspections under the direction of the engineering department.

The superintendent of bridges and buildings, in addition to other inspections, is instructed to make a regular inspection in the spring of the year of all bridges, culverts, and waterways, in company with his bridge foreman, reporting to the division engineer any defects found outside of ordinary current repairs on wooden bridges.

Copy of inspector's book, schedule, estimate sheet accompanying schedule, and bridge superintendent's monthly report, enclosed.

2. No regular bridge inspectors employed. For the special inspection of steel structures the division engineer usually details one of his assistants who has had charge of steel bridge erection and work of this character. This assistant engineer is accompanied by foreman of steel erection, and the detailed inspection of steel structures is made by these two men, with such assistants as may be necessary for doing the work properly and expeditiously.

3. The system for inspection is outlined under No. 1, also specimen of field books and reports, and the use made of same. The field books containing the notes taken on inspection are held in the office of the division engineer, where the schedule and the estimates for the coming year's work are prepared. All reports from the bridge superintendent pass through the division engineer, but are ultimately filed with the head of the engineering department.

4. Our system of inspection has proven very satisfactory, and about the only improvement I would suggest at this time would be that the spring inspection be done under the direction of the division engineer, as well as the annual inspection, and full reports made of these inspections.

5. The annual inspection is supposed to cover all points except the detailed examination of the steel structures or viaducts. The detailed examination of the large steel bridges or viaducts would in some cases take the time of the entire inspection party for several days. Their time cannot be devoted to this detail; as a result a general examination is made of such large structures with sufficient detail to give a good general knowledge as to their condition, leaving the examination of the entire structure, by detail, to a special inspection made by the assistant engineer and steel erection foreman detailed for this work.

As will be seen by the instructions in the field book, every bridge, culvert, waterway, or conduit, of whatever character or class, is to be carefully examined and notes taken stating its condition in full.

6. The inspection party travels on special train or hand cars as conditions may warrant. Where bridges and culverts are very close together, the best progress is made by the use of hand cars. Through our arid belts, where there are practically no bridges, and culverts are sometimes several miles apart, a special train is used. On parts of the line we furnish the inspection party a car with sleeping and cooking accommodations. On other parts of the line, where hotels are accessible, they are made use of.

The inspection party takes with it steel bars of the proper size and form for properly testing piles and other timbers, shovels and picks for digging around foundations, with augers for boring and mauls for sounding.

7. The track department is supposed to see that culverts do not become choked, and in a general way they are in proper condition, and to report any defects in bridges or culverts that may come to their notice or knowledge. Section foremen are instructed to look over all bridges frequently, reporting any defects they may see; this, however, is the extent of their inspection. They are not depended upon to know whether bridges are in safe condition or not, further than the reporting of any defects they may see.

8. Every culvert, of whatever class, should in my opinion be frequently inspected by the bridge department. We have every culvert carefully examined by the division engineer and bridge superintendent on the annual inspection.

9. In a general way we consider all openings in the road-bed, extending up to the track, bridges, with the exception of cattle-guards. Some of our cattle-guards partake very much of the nature of bridges; at the same time they are not charged to bridge work, and are included in our accounts under the head of 'Fencing and Cattle-Guards," and as a result they do not enter into the bridge accounts. This is undoubtedly to a large extent accountable for their not being classified and considered as a part of the bridging work. All cattle-guards of this character are inspected at the time of the bridge inspection, but separate report is made concerning them.

We have openings listed and numbered as bridges, of eight-foot span; probably nothing shorter. Some of our cattle-guards are ten-foot span, placed on piling, and quite as much a bridge in the ordinary sense of the word as some of the short spans we are maintaining for drainage. It would seem to me that the term "bridge" might properly cover spans down to eight or six feet in length, so long as the opening were truly a bridge in character and consisted of an opening in the road-bed extending to the bottom of the ties. I should say that a six-foot or eight-foot opening with a close floor, or covered top, providing for a continuously ballasted road-bed over the structure, might be more properly termed a culvert than a bridge. This, however, is probably to some extent a matter of custom.

10. The masonry and foundations of bridges should be inspected by the department in charge of the bridge maintenance to such an extent as may satisfy the officials in charge, as to their condition. For pile bridging, we insist that an annual inspection showing the exact condition of each pile in the structure, be made; that is, showing the actual amount of solid timber in each pile. In the case of frame bents the inspection notes are to show fully the exact condition of same as to decay and other defects so far as this is practicable. Our division engineer is supposed to have very full knowledge as to the exact condition of each bridge. His records of inspection and test very soon make him very familiar with each bridge and

structure. Further, he knows just when the piles were driven or other parts of the structure put in. His records show the character of the foundations, and other information which places him in position to form very accurate conclusions as to the condition of foundations that cannot be readily inspected, such as concrete or masonry abutments or piers. We have piers and abutments in some of our large streams that cannot be inspected, but with our knowledge of the manner in which they were put in, and there being no indications of any failures or defects, we have entire confidence in their sufficiency, and unless something should offer a reasonable question as to their insufficiency, they will be considered as sufficient for some years to come.

11. The organization of the bridge department on the Oregon Short Line is somewhat complex. The engineering department has general charge of all bridges, buildings, and real property belonging to the company. Bridges or buildings of importance are usually constructed or reconstructed under the direct charge of the engineering department, or by a special force reporting direct to the engineering department, either through the division engineer or the head of the department. Nearly all permanent bridge work is done by the engineering department.

The superintendent of bridges and buildings reports to the general superintendent of the Oregon Short Line Railroad, who is the head of the operating department, and reports to the general manager. The head of the engineering department reports also to the general manager.

The superintendent of bridges and buildings is supposed to do all bridge work, construction as well as repairs, which is not done directly by the engineering department. During the past few years large amounts of permanent bridge work have been done, and this has been done almost exclusively by the engineering department, leaving the superintendent of bridges and buildings to look after ordinary repairs, and the rebuilding of wooden trestles, putting in pipe culverts and work of this character, as well as general policing and looking after the proper repairs and the condition of all bridges.

The bridge superintendent employs all the bridge foremen on regular repair work and on construction work done under his direction. The bridge superintendent, however, has no jurisdiction over the forces employed by the engineering department direct, either on buildings or bridges. The engineering department supervises, to a certain extent, all bridge work; that is, all repairs and renewals of ordinary wooden structures and culverts are made upon the inspection report of the engineering department. The repair work to be done by the superintendent of bridges and buildings is, so far as practicable, outlined and based on estimates prepared by the engineering department, to the end that the officials of the company be informed as to about what repair work is necessary and the probable cost of same. This, of course, cannot be made to cover certain emergency work that is bound to come up during the year; yet the result of anticipating these repairs, outlining what is to be done, and stating the probable cost of same, has proven entirely practicable, and as the result, we have a very close estimate as to the probable cost of repairs and renewal work for the season, as well as furnishing bills from which renewal and repair material can be purchased for the coming year.

Note by Committee.—The printed instructions relative to bridge inspection and the field book are practically the same as on the Union Pacific Railroad. The field book, 4½ inches x 9½ inches, is similar to

the typical form "E," excepting that the blank page for remarks is omitted and in its place blank columns for reporting in detail the condition of trestle piles, caps, etc.

The schedule referred to by Mr. Ashton is an office-sheet report similar to recommended form "B," giving a "Statement of Bridges Requiring Renewal or Repairs," compiled from the inspection field book. This statement gives concisely the work proposed to be done.

The schedule is supplemented by a similar statement giving the estimated cost and columns for subsequently entering the actual cost for future comparison.

The bridge superintendent's monthly report is a similar sheet reporting what repairs had been actually made.

These three sheets, supplementing each other and based upon the field inspection report, form a very clean cut and elastic method for following up work reported in the field inspection as necessary or desirable.

J. B. Berry, Chief Engineer, Union Pacific Railroad:

1. With heavy increase of power and cars, and the large number of pile bridges, we keep one inspector going backward and forward all the time, looking over the pile bridges, more especially for broken caps or stringers. If an emergency arises he reports by wire; if not he reports once a week as to whether he has found anything broken or not.

2. Is answered in No. 1.

3. Have an annual inspection made by the division engineer and the bridge superintendent, of all bridges and culverts, beginning the first of September, and making it continuous until the inspection is completed. From this inspection a statement is made of renewals for the following year, and also what they would recommend for the succeeding year to that. A statement of all material required is made from the fall inspection for the next year, and requisitions or contracts made for same.

We anticipate the fall inspection by the previous year's record so that the principal assistant engineer or myself make personal examination of the bridges that are recommended for the following year, and if it agrees with the fall inspection report, then it is passed as noted above. From this inspection, both of bridges and buildings, a report is written in full; one copy for use of the bridge superintendent, one copy to the division superintendent, one copy to the office of the chief engineer, and one to the office of the division engineer.

Monthly statements are made out by the bridge superintendent, showing the work accomplished, and the annual reports are checked by these monthly statements. Estimates are made of the same, and actual cost of same are assembled so as to make a comparison.

4. Would recommend a capable bridge inspector for a large railroad. Keep him on the road all the time, making inspection of truss and girder bridges.

5. Answered by bridge inspection book, copy of which I send you.

6. Have stated how the inspection was made. If it is a very busy line, with a great many trains, a hand car is used; if not a very busy track, furnish an engine and coach to make the inspection. They use a long-handled prod; also have an auger, so that in the event of wooden truss bridges they can be bored.

7. Do not expect them to make any inspection, but the rule is for them to examine culverts and bridges, and especially see that the waterways are cleaned out.

8. Yes.

9. Twenty feet.

10. At the annual inspections they should be looked after very carefully, and also after any unusual flood water.

11. Under each division superintendent there is a bridge superintendent, or supervisor, who reports to the division superintendent, and carries out the recommendations of the bridge work as approved by the chief engineer, for which he gets detailed information from what is called a work order.

In the case of large pieces of masonry, or the erection of large girders and trusses, the engineering department organize force to do this class of work.

Note by Committee.—The printed instructions are in similar form to those of the Chicago & Northwestern Railway. The field book, 4½ inches x 9½ inches, is similar to typical form "E," excepting that the blank page for remarks is omitted and in its place blank columns for reporting in detail the condition of trestle piles, caps, etc. Three supplemental sheet reports are used, similar to those described for the Oregon Short Line Railroad, one a compilation from the field book of repairs required, a second one for estimates of cost and actual cost, and a third one for bridge superintendent's monthly report of work done.

Hunter McDonald, Chief Engineer, Nashville, Chattanooga & St. Louis Railway:

1. Frequent inspections by bridge supervisors are made on each division, generally about four times a year, needed repairs are noted and promptly made. No reports are made nor are any blanks provided for same. Annually the chief engineer accompanied by bridge supervisor of each division inspects every bridge on the system, preserving a record of his notes in a book so arranged that each year's inspection is always in sight. Repairs and renewals for the ensuing year are laid out on this inspection. Copies of these notes are furnished the supervisors for guidance and the work done is checked over on the next annual inspection.

2. We keep no bridge inspectors.

3. See answer to No. 1.

4. In addition to inspection, noted in No. 1, supervisors are required to ride over their entire division once a month on the engine of the fastest train in each direction, reporting results to the chief engineer and stating what steps have been taken to remedy bad riding.

5. On trestle work, decay of timber, loose bolts, surface and line engage our principal attention on all inspections; on truss bridges, condition of paint, loose or churning parts, condition of floor and masonry. On all bridges behavior under traffic is carefully looked after.

6. Annual inspection of bridges is made with engine and coach. Inspections by supervisors are made by motor cars and light hand cars. A long-handled hammer and small steel bar for testing decayed timber are usually carried.

7. We do not depend on track department for inspection of bridges or culverts, except that track walkers are required to sweep cinders off of iron and masonry of bridges once a week. Section men are required to report any defects which they may find and to remove driftwood from the mouth of culverts and small trestles and inflammable material from under all trestles.

8. Bridge supervisors have charge of bridges and culverts. Inspections of culverts are usually made by the chief engineer in the spring in the same manner that bridges are inspected in the fall, but only such culverts as are reported giving trouble are examined. Supervisors make inspection of culverts in the same manner.

9. I have never been able to reach a satisfactory distinction between a culvert and a bridge. We number all bridges, and usually put numbers on everything which has cross-ties regardless of its length. Stone arches of 40 and 50 feet span, on this plan, are considered culverts. Your committee would confer a great benefit on the profession if satisfactory definitions of bridges, culverts, trestles, and viaducts can be reached.

10. I consider the masonry and foundation of bridges one of the most important items of inspection.

11. The chief engineer has direct charge of all bridges and culverts, division superintendents not being responsible therefor. Bridge supervisors on each division report directly to the chief engineer. Bridge supervisors have under their charge foremen of masonry, concrete gangs, and carpenter gangs. These gangs are properly equipped for their work, being housed in boarding-cars for convenient moving from place to place.

I enclose copy of foreman's monthly report of work done during the month; also leaf from bridge inspection book, which is used by all bridge supervisors and the chief engineer.

Note by Committee.—The inspection book is 8½ inches x 4½ inches. On the left page there are blank columns for bridge list and data relative to date of building masonry, piling, iron, paint, deck, etc. The right page is divided into four sections, each one for recording the inspection and construction notes for various periods or years.

I. O. Walker, Assistant Engineer, Nashville, Chattanooga & St. Louis Railway:

I have consulted with our chief engineer, Mr. Hunter McDonald, and he has furnished you an answer to your circular for our system.

In his answer to Question No. 7.—I think you and every other bridge man is aware that section men do as little of this sort of work as they can.

Question No. 8.—I would emphasize further than our chief engineer has and say that culverts should certainly be in the hands of the bridge department.

Question No. 9.—In answering this question put by committee of the Railway Engineering and Maintenance of Way Association, I used this language: "I think a structure is a bridge when it depends for its support upon distinct piers or bents. It is a culvert when it depends upon the invert or bottom of the structure, as the case may be."

Will state further that for culvert inspection I always use a mirror about 16 inches x 20 inches in size to throw the sunlight into the culvert. I find it of immense assistance in detecting cracks or anything out of shape in pipe culverts from 12 inches to 24 inches in diameter.

Even where it is necessary to have a man go through, it is of great assistance to flash the light behind him so he can examine everything closely. This would naturally come under the head of tools used in inspection.

R. Montford, Chief Engineer, Louisville & Nashville Railroad:

I send you herewith "Instructions for Inspection of Bridges, Trestles, and Tunnels," dated February 1, 1903. This book answers all the questions, I think, called for in your circular, and shows the system used by this road for the inspection of bridges. I also enclose form 657, sheet No. 1, which is a sample. Each division has a sheet similar to this one, and on these sheets the bridge foreman reports to the bridge supervisor, and the bridge supervisor to the division superintendent and the bridge engineer, and the division superintendent and the bridge engineer to the chief engineer. I also enclose form 633, showing the weekly report of work done by each working gang made out by the bridge supervisor; also form 632, showing the work contemplated to be done during the coming month by each working gang.

In addition to the above reports we have a bridge engineer, who goes over the entire system on a hand car, and makes inspections and reports direct to the chief engineer, who issues such instructions as he thinks proper to the division superintendents. This bridge engineer also inspects the new bridges in course of construction, reporting to the chief engineer.

Note by Committee.—Form 657 is an office form, issued as a separate sheet, 23 inches x 18 inches, with the bridge list and data printed on the left and columns for date of inspection, condition of masonry, and condition of structure at date of inspection.

Charles S. Churchill, Chief Engineer, Norfolk & Western Railway:

1. Our system of bridge inspection requires that the general bridge inspector, who is an assistant of the chief engineer, shall go over the entire system twice each year, the main inspection being held in the fall. The regulations covering inspection are clearly shown in the bridge inspection book.

2. We keep a regular bridge inspector whose title is general bridge inspector.

3. The master carpenter is held responsible for the bridges on his division, and is required to inspect bridges currently and make a report thereon after a personal inspection once each two months on the sheets. Form M. W. 46. These reports are filed in the office of the chief engineer, where estimates are made at the beginning of the year of repairs to be undertaken during that year.

4 and 5. Our bridge inspection includes every class of bridge construction; condition of steel structures, rivets, etc.; and also condition of masonry, and detailed condition of all timber work.

6. Our general bridge inspector goes over the road with a gasoline motor car. The tools that he and the master carpenter take with them are generally auger and hammer for testing rivets; the hammer has a sharp point also for testing the timber. He also has a caliper, rule, and tape line.

7. The roadmaster inspects culverts periodically, and is held wholly responsible for culverts. The annual inspection of culverts is made in November each year, from which estimate is prepared in the office

of chief engineer of the repairs to be undertaken during the following year. The roadmaster of each division reports to the superintendent of the division, and the condition of culverts is reported on form M. W. 47, this report being made by the superintendent from information furnished by the roadmaster, and reaches the office of the chief engineer through the general superintendent.

8. We think it is unnecessary for the bridge department to inspect culverts unless some question arises as to amount of drainage, form of construction, etc.

9. The minimum opening of road-bed which we class a bridge is 8 feet.

10. The master carpenter is held responsible for foundations of bridges that are constructed by company forces, and is obliged to report on the condition of foundation before actually starting the laying of new masonry. New masonry laid under contract is not started until foundation has been examined and approved by the representative of the chief engineer.

11. The organization of this road makes the division superintendent responsible for the proper repair and maintenance of structures on his own division. He has a roadmaster for track work and culvert repairs, and a master carpenter for bridge work. The division superintendent reports to general superintendent, and general superintendent reports to the chief engineer in maintenance matters. The chief engineer is assisted by principal assistant engineer, bridge engineer, and assistant engineers; also general bridge inspector, and through these assistants new structures are erected, and through the general bridge inspector the method of inspection is carried out as provided in the bridge inspection book. The general bridge inspector and the master carpenter of the particular division on which inspection is being taken both take record of the inspection. The master carpenter uses his record for reporting to his superintendent and for making requisitions for material. The general bridge inspector uses his copy for preparing estimates for the ensuing year, and for checking requisitions as they come through to the chief engineer, and forms the basis of providing an allotment of forces by the chief engineer for the year's work. The allotment of forces and the work to be done for the year is laid out in accordance with work sheets.

Note by Committee.—The field inspection is recorded on a form similar to recommended form "C," issued in a book, 5½ inches by 8 inches, with instruction rules printed in front of book. The headings are: Bridge No., Spans, Kind, Length, Height, Date Inspected, Condition of Bridge and Description of Work to be Done, Oak, Pine, Cost of Material, Labor, Total Cost.

Form MW 46 is an office sheet form, 19 inches by 17 inches, with bridge list and data printed on left, and columns for date of inspection, remarks on condition, and repairs made since last report.

Form MW 47 is similar to recommended form "B," issued in sheets, 8¼ inches by 13¾ inches, and used for inspection of culverts, pipes, pit cattle-guards, etc. The headings are: Location, Description, Size or Span, Length, Number of Tracks, Condition, Remarks.

The "Work Sheets" referred to by Mr. Churchill give very complete data as to estimated and actual costs of repairs, also comparative forecasts of relative costs of repairing or replacing, more particularly with reference to filling in trestles.

W. Hunter, Chief Engineer, Philadelphia & Reading Railway:

On our lines the foremen carpenters and foremen masons are required to make frequent examinations of all bridges and their foundations.

In the spring of the year the engineer of bridges, accompanied by the foremen carpenters of the various divisions, goes over the road in special train, and examines all the bridges of ten feet span and over, including arches. The tools used are hammers, augers, and pointed bars, and the principal points examined are the condition of joints, adjustments, bearings on masonry, painting, floor, and masonry.

When field examination is completed on each division, a type-written report, mentioning each bridge and such repairs as are required, is made to the first vice-president, who transmits a copy to the division superintendent, who makes the repairs noted.

In addition to the annual inspection the engineer of bridges makes more frequent inspection of such bridges as require it, and an inspector is kept constantly at work going over the details of the bridges.

Culverts should be inspected and kept up by the roadway department.

We class as a "bridge" openings of 10 feet or greater.

Masonry and foundations are examined at the annual inspection, but frequent examinations are made by foremen masons, particularly after heavy freshets.

The bridge department consists of the engineer of bridges, several draftsmen, shop, mill, and field inspector.

I. S. P. Weeks, Chief Engineer, Burlington & Missouri River Railroad in Nebraska:

1. Our bridge inspection is made in the fall and in the spring by the general bridge superintendent, accompanied by the division superintendent on each division. We have no blank form of report, but the report is written and sent to each division superintendent immediately after the inspection, with instructions to carry out the suggestions offered.

2. Our bridge inspectors are the general superintendent of bridges and the division superintendent of bridges, who make a semi-annual examination of all the bridges on the road.

3. Our inspection is made semi-annually. The reports are written as soon as possible after the inspection. They are submitted to the chief engineer for approval, and filed ultimately in the office of the chief engineer.

4. There is no other class of bridge inspection that I would recommend.

5. The bridges are examined as to their condition; the condition of the ends of the stringers examined closely; cracked and defective stringers are looked for; defective or rotten caps; the piling is examined; in short, a close examination is made by two men of the bridges, and notes taken recommending either a renewal or certain patching up, if such patching will answer in the opinion of the superintendents.

6. The bridge superintendent has a special train; he stops at each bridge; walks under the bridge, examining all he can see, and over the bridge on top of the ties. Previous to the examination of the bridges in the fall, all the piles are dug around by the bridge men,

so that their condition at the ground line can be critically examined; all of the rotten sap is cut off by the bridge men and the condition of the piles examined. The bridge superintendent usually carries a light steel bar, with which he can test the condition of the wood if necessary. He also carries a brace and bit, so he can bore the wood if he is suspicious of it, and in case of very grave suspicions, he recommends the thorough overhauling of the bridge, examined by a local bridge foreman.

7. We do not depend upon the track department at all for inspection of bridges and culverts.

8. Our culverts are inspected by the local bridge foremen. The large culverts are inspected by the general bridge superintendents in company with the division superintendent.

9. Any opening coming up to the track which has any kind of stringers and ties, a clear opening of 5 feet or over, is called a bridge.

10. The masonry and foundation of bridges, I think, should be inspected by the bridge department very carefully. Our records usually show the depth of these foundations, and also the character and kind of material, and inspection shows how the material is lasting, and necessary repairs can be suggested on each inspection.

11. Our organization of the bridge department is as follows:

Our whole road, about 4,500 miles, is divided into five operating divisions. Each of these divisions has its own superintendent, and each of the divisions has a bridge superintendent. The bridge superintendent reports to the general bridge superintendent in all matters relating to the repairs of renewals of bridges. The bridge superintendent is under the authority of the division superintendent, and all pay-rolls are carried in the division superintendent's office.

All plans of permanent structures are made in the chief engineer's office, the general bridge superintendent being an adjunct and a part of the chief engineer's operating force.

All the records of the bridges are kept in the chief engineer's office, subject at all times to the inspection and use of the general bridge superintendent.

In addition to the method of bridge inspection outlined above, twice each year our high authority on bridges, our consulting engineer previous to his death, now our general bridge engineer, inspects all iron bridges of spans of 24 feet or more. This inspection is made in company with the chief engineer of the road, with the general bridge superintendent and with the division bridge superintendents on their respective divisions.

This work is done with a special train, which stops at all bridges of the size given, and the bridge engineer of the system makes a report of the condition of all these bridges and makes recommendations for their repair, and, if necessary, for their renewal and change.

The record of our inspection is typewritten and sent to the general manager's office, where it is filed. Copies of it are filed in the chief engineer's office.

We do not have a very elaborate system of blanks. Our superintendents and engineers are provided with a list of the bridges, showing their number and location, showing the length of the bridges, the size of the chords in stringer bridges, the date of erection, and the remarks and suggestions that were made on the previous inspection.

All of our masonry structures have marks showing the depth to the foundation. All of our pile structures have marks showing the distance to the point of the pile, so that on inspection it can easily be ascertained whether the ground is washing dangerously near the points of the piles and the bottom of the foundation, and gives us an opportunity to prevent trouble.

B. H. Bryant, Chief Engineer, Colorado Midland Railway:

You will find attached copy of our form, No. 1501, on which our bridge inspector makes his report showing the condition of bridges and other structures. The ruled side of this form is used by the foreman of the bridge gang that makes the repairs to report the labor and material expended, and such other information as we require of him.

In regard to your questions I will say:

1. It is our intention that every bridge on our line shall be inspected once every thirty days, and as a rule this is done.

2. We keep a regular bridge inspector, employed to inspect bridges and do nothing else.

3. The general foreman of bridges and buildings inspects bridges himself as he goes over the road and has opportunity, and once a year I aim to make an inspection of every structure on the road with the bridge inspector and general foreman of bridges and buildings, and usually have the road masters with me at the same time, that track matters may be taken up and discussed in connection with the bridges. My last general inspection was made during the months of May and June last year.

4. In riveted work we expect our bridge inspector will at least once a year tap every rivet in every riveted structure on the line, to be sure that no rivets are working loose as the result of somewhat excessive strains our iron bridges are subjected to on account of increase in the weight of our engines and other equipment.

5. Inspection is supposed to be close enough to show that every member in every structure inspected is in proper condition to be continued in service.

6. Inspector is provided with a light velocipede car which he is able to handle alone, but on account of the heavy grades that are on our line he is compelled to take his car to the summit of the grades on our trains and ride down hill to make his inspections. He is provided with a hammer for sounding timbers, with an auger for boring if necessary, and with a bar with a broad blade on one end and a sharp point on the other. The shovel blade on one end is used to dig out piles and timbers that are partly buried that examination may be made below the ground line, and the sharp point is made for prodding into the timber to see if it has begun to decay.

7. We do not depend upon the track department for the current inspection of bridges, but do expect every section foreman will send report by wire if any bridge on his section seems to require attention. We require section men to keep culverts free from brush, dirt, and other such things that they may be in condition at all times to carry off water that may accumulate above our embankments.

8. We hold our bridge department responsible for culverts as well as bridges.

9. We style everything a bridge that has an opening up to the bottom of the ties in our track, even if it is not more than four or six feet long.

10. We expect our bridge inspector and others holding positions of responsibility in the bridge and building department to watch the masonry and foundations of the bridges just as they do all other portions of the structures. Our bridge and building department is made up of a general foreman of bridges and buildings, a bridge inspector, a general foreman of water service, and as many gangs of carpenters of eight men each in charge of a foreman, as may be necessary to handle the work we have on hand from time to time.

Note by Committee.—The form referred to above is a foreman's work report, on the blank back of which the bridge inspector reports the condition of the structure and work that has to be done.

L. F. Goodale, Chief Engineer, Burlington Route:

1. We have no regular system for current inspection of bridges. It is made irregularly by bridge men, bridge foremen, and bridge superintendents. No special reports are made and we have no report blanks.

2. We do not keep a regular bridge inspector for the current inspection of bridges.

3. All truss and girder bridges over twenty feet in length are inspected semi-annually by the consulting engineer accompanied by the chief engineer, superintendent of bridges, and superintendent of masonry. The report is made by the consulting engineer to the second vice-president and general manager, copy being furnished to the chief engineer. I presume the report can be said to be ultimately filed in the office of the general manager. We have no regular form of report, but typewrite the notes made in the field. On receipt of this report the general manager advises either the general superintendent or chief engineer, or both, to do the work as recommended.

4. Once a year a specially engaged consulting engineer examines our large bridges across the Missouri and Mississippi rivers. He is accompanied by the consulting engineer, chief engineer, superintendent of bridges, and superintendent of masonry, and his report is made to the second vice-president, copies being furnished to the general manager and chief engineer and instructions are given by the second vice-president to the general manager and he to the general superintendent and chief engineer to have the work done.

5. This is a hard question to answer. The whole bridge is intended to be inspected. One of the particular things is we examine the attachments of the stringers to the floor beams and floor beams to posts in Pratt spans.

6. For the inspections described under three and four, special car and train is furnished for the inspectors and a number of tools are carried; an auger, hand level, machinist's hammer, tape, and a bar for "prodding" piles.

7. Track department is supposed to inspect bridges and culverts to see that nothing material is out of the way.

8. Do not think it necessary to have the bridge department inspect culverts.

9. All openings having an area of two square feet and over are included in our bridge list. It is pretty hard to fix a minimum limit to be called a bridge, and we have no minimum.

10. Bridge departments need not inspect masonry and foundations if there is a masonry department; otherwise I think the bridge departments should have the whole care of masonry and foundations.

11. Our bridge department is organized as follows: Superintendent of bridges and buildings and various foremen under him. Superintendents of bridges report to the superintendent.

C. J. Parker, Chief Engineer, Rutland Railroad:

1. Inspections are made of all structures quarterly, and more frequent, where conditions demand, by bridge inspector. Annual inspection of all structures made by the supervisor of bridges and buildings; first, second, and third quarter by bridge inspector, to report on any changes that may take place, and changes checked off from annual inspection. Blank marked "A" used for annual. All items for renewal or radical repairs marked "A" that are urgent; "B," that ought to be done but can wait until next inspection, and "C," that can safely wait one year.

2. Yes.

3. For quarterly inspection the inspector examines from annual inspections and reports on any additional defects or any work that has been done since last inspection. Inspector's reports are sent to supervisor of bridges and buildings and commented on; checked off and forwarded to the chief engineer; copy retained in supervisor's office.

4. Yes, that after any storms of importance, inspections should be made by the section foreman and track supervisor, where possible, to determine if structure has been affected from wash, scour, etc.

5. In the annual inspection all points are carefully examined as to settlements, conditions of masonry and foundations; superstructures as to elevation and line, condition of rivets, roller adjustment, etc. On wood, a thorough examination of any parts affected by contact. The following quarterly inspections are to determine any additional changes and to see if work done at intervals is O. K., and from this check annual inspections.

6. Inspector gets over road with motor car. Tools employed consist of brace and bits, log maul, rivet test hammer, steel test bar and level, and plumb bob for masonry and span tests.

7. Supervisors of track are to inspect superficially quarterly, and report on anything, in their opinion, that needs attention in thirty days or less. Report made on blank marked "B."

8. Culverts that would affect the traffic of road by neglect, or that require the attention of carpenters and masons, should be inspected annually by the supervisor of bridges, along with bridge inspector; should be inspected each quarter by supervisor of track and each section foreman once every week.

9. Any opening or span of 13 feet or over requiring girder, rail floor, etc., but not stone arches.

10. To the utmost possible.

11. The organization of bridge department consists of supervisor of bridges and buildings, assistant supervisor of bridges and buildings, who also acts as inspector, and division gang foreman in charge of restricted territory, and such additional assistance as the work demands, under the direction of the supervisor of bridges and buildings or his assistants.

Note by Committee.—The bridge inspector's report "A" is a single sheet, 11½ inches by 9 inches, similar to typical form "F." The supervisor's report is a single sheet, 8 inches by 7 inches, similar to recommended form "B," used for bridges, culverts, buildings, and all classes of structures.

J. A. Atwood, Chief Engineer, Pittsburgh & Lake Erie Railroad:

1. Current inspection of bridges is made by local foreman of carpenter gang, who reports to the superintendent of bridges and buildings. He reports as occasion demands. We have no blanks for this purpose.

2. We do not.

3. Semi-annual inspections are made by the chief engineer, accompanied by his assistant chief engineer, division engineers, superintendent of bridges and buildings, consulting engineer for bridges, and a stenographer. Notes are taken of the condition of each bridge and are compared with the notes taken at previous inspections, and such action is taken as seems to be necessary after such comparison has been made. These notes are on file in the chief engineer's office.

4. None.

5. Plans and strain sheets are taken along on these trips and are examined, and the bridges themselves are carefully looked over by our bridge expert for any signs of weakness.

6. The inspection is made by a special train.

7. We do not *depend* on the track department for inspection of bridges, but expect them to report anything which they find wrong.

8. Culverts should not be inspected by bridge department.

9. Ten feet.

10. Masonry and foundations of bridges should be subject to inspection by bridge department for the sole purpose of reporting anything which goes wrong. The responsibility for the complete inspection and maintenance of the masonry and foundations should, however, rest with other parties.

11. See No. 1.

G. W. Smith, Division Erecting Manager, Western Division, American Bridge Company (formerly Superintendent Bridges and Buildings, Chicago, Milwaukee & St. Paul Railway):

The subject being considered by your committee is one in which I am much interested, although my experience has been with a line on which a large portion of the volume of bridge maintenance consists in the construction of wooden bridges. With the C., M. & St. P. Ry. Co. I had a few years' experience as an inspector and several years' experience afterwards in criticising the reports and recommendations of inspectors. As a consequence I have developed some personal ideas regarding the subject which are, perhaps, colored largely by the system in effect on the C., M. & St. P. Ry. That system will probably be outlined by other members of our association, and I will, therefore, frame my replies to your questions so they will indicate my idea of good practice regarding the inspection of wooden bridges. The exact distribution of such duties among employees must be determined largely by the organization in effect, and so far as possible the

essential points of inspection should be considered independent of any scheme of organization. I will reply to your questions by the number in the circular.

1. Regular inspections of bridges should be made twice each year. One of these inspections should outrank the other, and might be called the official inspection. From this inspection the work for the year can be outlined and the material estimated. It is consequently preferable that the official inspection be made in the fall of the year preceding that in which the work is to be done. On this inspection there should be required the presence of a regular inspector and a local representative of the bridge department.

2. The employment of a regular bridge inspector is certainly preferable on lines large enough to warrant this arrangement.

3. Quarterly inspections are unnecessary and undesirable. Semiannual inspections are good practice, but one of these should outrank the other and should outline all the work required for a year. The secondary inspection should be merely a protection against surprises. I never have used any report blanks, although reports naturally reduce themselves to a uniform style. Reports should contain a specific description of the work to be done and the material required for same. Where there is any possibility of question, the report should contain alternatives. Where a revision of the line or a different style of structure seems advisable, the report should contain recommendations to that effect. The inspection reports should be passed upon by some one in the department competent to criticise and to control the work to be done in conformity with the policy laid down for the department. After drawing off the reports all the information required to outline the work, the inspection report should be filed in the general office of the bridge department. Such record as local offices may need can be provided according to circumstances.

4. I am not sure what this question may cover, but would advise that on lines where the policy is to replace wooden bridges with stone and steel construction the engineer who is to have charge of the latter should, if possible, be the official inspector of the line. This practice gives the engineer a greater familiarity with the waterways, the traffic requirements, and many other conditions that must be considered, not only in designing the structures, but in carrying on the work of reconstruction. This engineer should later on accumulate all the information necessary for the use of the drawing room in making plans for the new structure, and should gather information necessary to assist in determining the style of structure to be built.

6. The inspection should be made in any way that will permit a thorough examination of all structures, regardless of the length of time required. Probably the most economical and satisfactory way is to make the trip on a hand car or a motor car. In addition to those who are taking notes from which the reports are made, there should be a sufficient number of assistants to examine the structures in detail as directed by the inspector. On lines where a large portion of the bridges are constructed of wood these men will naturally be bridge carpenters, and ordinarily there should be not less than two and perhaps not more than four.

For the inspection of wooden bridges the men should be equipped with small augers for boring timbers, with sharp-pointed bars for testing the piles, and with a hand axe, wrench, etc., for various purposes.

7. The track department can be depended upon to furnish a hand car and men for carrying an inspector over the line, but if there is much work for the inspector to do, he will prefer to have his own hand car and crew. So far as judgment of the bridges is concerned, the track department should not be depended upon for anything.

8. Culverts should be inspected by the bridge department, provided they are of such size or capacity that a failure would be a menace to the safety of the traffic.

9. The line between structures which are bridges and those which are not is, in my experience, drawn more for the purpose of eliminating from the bridge department duties and records of those structures which can be left in the hands of the track department with safety and economy. In my opinion every opening which is not covered by embankment or ballast and which is spanned by stringers, regardless of their length, should be considered as a bridge.

10. On all lines of sufficient size to warrant the organization of a bridge department that department should inspect the masonry and foundations of bridges.

11. Since I am no longer employed by any railway company I cannot outline the organization of any individual department. I assume that for the use of your committee you would not care for an outline of my idea of organization, and therefore will not go into the matter any farther.

In general, I will say that in my opinion bridge inspection cannot be reduced to a system. The only way to secure satisfactory results is to get the inspector, educate him by experience, and then depend upon him to make the inspection.

An inspection when properly made must consider the whole situation broadly, and while the inspector must be an expert in the judgment of timber and familiar by experience with its capacity, its rate of deterioration under various conditions, and its capacity for furnishing surprises, he must also be competent in some measure to suggest, while at the site, the design for a new structure when reconstruction is necessary. This requirement leads to the selection of an engineer, and nothing less, in my opinion, will be found satisfactory.

A. Shane, Superintendent Roadway, Toledo, St. Louis & Western Railroad:

We are very naturally of the opinion that our method, or the one the individual writing uses, is the best. So I beg to advise as to the *modus operandi* on this road.

First, surveillance of all bridges is made by section foremen as often as possible, at least once a week. A competent bridge inspector is kept going all the time, and he makes the trip over the road at least once every three months. He makes a careful examination of all structures, reporting their condition (and calling particular attention to defects that may need prompt attention), using forms such as I attach herewith. These reports are carefully gone over and such as are deemed necessary filed for reference and used at the semi-annual personal inspection of the superintendent of roadway. Our bridge inspector is required to examine closely every member of the structure, and in pile or wooden structures or wooden trusses, members are sounded or bored when deemed necessary to determine the amount of deterioration.

Our inspector is furnished with a four-wheel car and he is charged particularly not to hurry over his work. The fall inspection of

bridges made by the superintendent of roadway, accompanied by the regular bridge inspector, is made with the view of determining the work necessary to be done during the remainder of the season and lay out work for the ensuing year. A report is carefully compiled at the end of the year and submitted to the management, showing the condition of all structures and making such recommendations as are deemed advisable. The spring inspection is to determine the order in which the work should be taken. I find that I very seldom deviate from plans laid down in these inspections. Our section foremen are charged particularly about watching culverts and their inspection and reports are depended upon in regard to these openings, and as much importance attached to them as that of the bridge inspector, who is also required to look them over carefully and make report for each opening. The minimum limit of structures classed as bridges is fourteen feet.

As to the extent of inspection by the bridge department of masonry and foundation, since they are all taken care of by the department on this road, the inspection must necessarily be made by them.

As to the organization of the department on this road, the head is the superintendent of roadway. The method of dividing the department into divisions has been abolished.

We have as many construction gangs as the requirements of the road will demand, and other gangs, termed "floating gangs," for light repairs, assigned to certain territory. These foremen are instructed to carefully look over all structures as they move along, making reports from time to time, whenever they deem it advisable, without any regular form or specified time. I believe all such work should be done by competent men and in a systematic manner and they should be cautioned against anything that tends toward being an alarmist, since considerable expense might be incurred by having attention called to structures unnecessarily, but in all cases it is best to take the safe side.

Special instructions, you will note, are printed on back of reports to govern inspectors.

Note by Committee.—The inspection blanks are separate sheet reports. For trestles, 11 x 8½ inches, similar to typical form "G," with vertical columns for the various parts of the trestle and horizontal spaces for noting the condition of each part of each bent. The headings are: Number of bent from east; piles; caps; posts; intermediate caps; sills; stringers; ties; guard rail; diagonal braces; sway braces; line girts; cross girts; remarks.

For truss bridges, the forms are 20 x 5½ inches, similar to typical form "F," with column headings: Number of bridge; action under trains; approaches; guard rail; alignment and surface; ties; chords; main and counter braces; rods; floor beams; bolts; castings; bedplates and rollers; rivets; paint; abutments and piers.

J. A. Dodson, Assistant to General Manager, Southern Railway:

1. Trestles are personally inspected every two months by the bridge supervisor of the division.

Bridges are inspected every three months by bridge supervisor of the division, together with the division roadmaster.

The structures are examined from time to time, as may be necessary, by the engineer of maintenance of way, and the engineer of bridges and buildings, or his assistants.

2. No, sir.

3. Copies of inspection blanks are herewith attached.

4. Only as above.

5. Largely as referred to in the printed blank attached.

6. Hand car, small hammer, and bar.

7. Track department should make frequent superficial examinations.

8. Culverts should be inspected by the track department and track supervisor.

9. Bridge is considered as having trussed supports for the horizontal members.

10. Masonry and bridge foundations should be inspected by the roadmaster and bridge supervisor, with constant inspection by the track department.

11. Bridge department is a bureau of the maintenance of way department, reporting through the roadmaster or division engineer, superintendent, engineer of maintenance of way, general superintendent, engineer of bridges and buildings.

Note by Committee.—The inspection report is a single sheet for each bridge, folded double letter paper size, enumerating 48 items to be answered as to condition and action taken.

O. D. Killebrew, Resident Engineer, J. W. Morgan, Supervisor Bridges and Buildings, and W. A. Fort, Supervisor Bridges and Buildings, Southern Railway:

1. Quarterly inspection by resident engineer and supervisor bridges and buildings. (Specimen blank enclosed.)

2. Do not have regular inspector. The work is done by supervisor of bridges and buildings.

3. System of bridge inspection, quarterly by resident engineer and supervisor of bridges and buildings. Reports sent to engineer of bridges and buildings and filed in his office.

4. On some structures, such as Howe truss, combination trusses and light iron spans, we make monthly inspection and report on form.

5. First, the condition of masonry. Second, see that all members are in proper adjustment. Third, condition of pins; see that all are tight. Condition of rivets in truss and floor system; look after rollers and see that truss is plumb.

6. Inspection made on lever car. Tools, light hammer and pinch bar.

7. Do not depend on track department for report as to condition of bridges, but do to a certain extent on culverts and trestles.

8. Yes, think it necessary for bridge department to make inspection of culverts.

9. Twenty-five feet.

10. Think the inspection of all masonry and foundation work should be inspected by bridge department.

11. Bridge department on a division consists of four regular bridge and trestle forces of foreman and ten men, one house force of foreman and ten men, one extra gang for construction work, one fore-

man and ten men, and one mason force of foreman and from six to eight men. Bridge supervisor reports to and receives all instructions from resident engineer.

Our trestle inspection is made every two months and report made in note book to resident engineer, who forwards same to engineer of bridges and buildings.

J. P. Snow, Bridge Engineer, Boston & Maine Railroad:

Replying to your circular letter regarding bridge inspection, I will begin by answering inquiry 11.

Our road is maintained by the division authorities, each division covering an average of nearly 300 miles. The responsibility for all structures is in their hands. The chief engineer makes plans for and executes all contract work and other improvements of large magnitude. The bridge engineer is subordinate to the chief engineer, and not only makes plans for new structures, but furnishes reports for various commissions and is supposed to keep on file a record of our structures, which it is necessary, of course, to keep up to date by an acquaintance of such changes as are made. To get this information, and also for the purpose of having general knowledge of the condition of the bridges, we have a system of regular bridge inspection.

1, 2, 3. We use a member of the engineering force to make bridge inspections, the great bulk of which are yearly. A few, perhaps a score in all, of the structures which are somewhat unsatisfactory, we inspect at intervals of three or six months, depending upon the condition of these structures. I enclose herewith a specimen page from our field book, which I think explains itself. I also enclose a set of instructions, which is pasted on the front cover of each book of blanks. Each book contains 100 blanks, made of a size which can readily be carried in the pocket, and the slips are torn out when filled in and returned to the bridge engineer. The inspector also, if he desires, fills out a duplicate, which he retains for his information in the future. After these blanks are examined they are entered in a large book, which contains all of the bridges for a given division. One page is devoted to each ordinary structure, and the substance of the report is entered on a single line, using abbreviations freely. These reports are then filed away in tin cases, so that they can be found in the future if required.

4. The division authorities are expected to keep posted as to the condition of their structures, but they have no formal method of inspection which results in a record. Personally, I would recommend that the track men should report any obvious defect which they observe in their daily perambulation of the track, and that the regular annual or other inspection should be made by the supervisor of bridges, and his report, after being examined by his superintendent, be returned to the chief engineer's office. This, however, is not our system.

5. The blanks submitted answer this question.

6. We provide inspectors with light velocipede cars, which they use and leave over night at the stations which they reach, provided they intend to start from that station the next morning. The only tool which they regularly carry is an inspecting hammer with a spike point. They use this hammer for testing rivets in iron bridges, and it is also quite useful in determining the soundness of timber. Small augers are used on special occasions, but I do not think it advisable to bore timber at each regular inspection.

7. So far as the inspection described above is concerned, pertaining to the engineer department, the track department is not depended on for assistance.

8. I think that box culverts should be inspected, but I am very glad to have it omitted from our inspection, on account of the large amount of work involved in going up and down banks to make this inspection. It would considerably more than double the work which we now do. I think these should be inspected by the track department reporting to the roadmaster.

9. We inspect every opening, no matter if it is not more than two feet. We have no absolute line of demarkation between bridges and culverts. Our system of numbering, however, makes a division between openings of six feet span and over and those of less than six feet span; that is, we give the former a full number and what we call a bridge post for a marker. The latter we give the number pertaining to the bridge next towards the origin of numbers and add a letter, the marker for these small openings being of a different form and much smaller than the bridge posts.

10. I think the masonry and foundations of bridges should be inspected as much as any portion of the structure.

Note by Committee.—The inspection form is a small book, one page for each bridge, with stub and printed side items, similar to typical form "D."

C. P. Austin, Supervisor Bridges and Buildings, Boston & Maine Railroad:

1. Semi-annually, with inspection car. Myself, foreman, and two men.

2. No.

3. Answered in No. 1. No blanks. Report sent to superintendent of the division.

4. No.

5. Weakness, decay, loose rivets, or any other defects liable to occur to all wood or iron bridges.

6. Answered in No. 1. But carry auger, bar, hammer, etc.

7. None.

8. Yes, to a certain extent.

9. Six feet.

10. To the limit of safety.

11. None on my division.

J. P. Canty, Supervisor Bridges and Buildings, Boston & Maine Railroad:

The following answers will apply to the Fitchburg division of the Boston & Maine Railroad:

1. Herewith specimen of report blanks used on our current inspection. These are bound in book form, with stub, and inspector keeps a duplicate of report. Inspector starts in about April 1, and keeps continually at work till about August 1. During this time every

bridge on the division has been examined carefully at least once, and some have been inspected as many as four times. Starting in once more about September 1 the routine is repeated, and examinations are completed about January 1.

2. Yes.

3. Our system answers for a current and also a semi-annual inspection, as every bridge is inspected and report made on same at least twice each year. Reports are sent to, examined by, and filed in office of supervisor of bridges and buildings. Twice each year a list of defective structures is made out, and these bridges are examined personally by supervisor, who then makes provision for repairs or otherwise asks for authority to rebuild.

The engineering department also makes an independent examination of bridges, and reports are sent to and filed in office of chief engineer. From these reports others are made to comply with the regulations of the different states.

4. I think the system used on the Boston & Maine Railroad has merits. The supervisor is directly responsible for the maintenance of structures, but the engineering department inspectors may and do find defects not noticed by the men directly responsible.

5. A thorough examination of the whole structure, including masonry, is made.

6. Inspector travels over road on foot; carries a small ship auger, a pinch bar, a strong awl or punch, and a short straight-edge.

7. We do not depend on track men to report on condition of bridges, but we frequently receive information from them. Section foremen make the only inspection which we have for culverts.

8. No.

9. Six feet.

10. I think it is a good idea to have it understood that section foremen are supposed to look over abutments and piers frequently, nevertheless, the bridge men should include masonry and piers in their inspection reports.

11. Our road is organized by divisions, each division being entirely independent in organization. The engineering department covers all divisions, has charge of designing structures, and takes care of all contract work, but is not responsible for the maintenance of structures.

The following shows, in a general way, the organization of the portion of the road department on this division which handles the bridge work:

Whole division.—Supervisor bridges and buildings; clerk; stenographer (share with roadmaster); storekeeper with crew (share with roadmaster); foreman mason and crew; foreman painter and crew.

Five sections, each with a foreman carpenter and crew.

Edward C. Carter, Chief Engineer, Chicago & North Western Railway:

1. We have two regular bridge inspectors who are constantly on the road inspecting bridges.

2. Answered in No. 1.

3. We have an annual bridge inspection in September, made jointly by the division engineer and the superintendent of bridges and

buildings, when recommendations for the next year's work are made. I attach specimen of report blanks. The division engineer reports these to the chief engineer and the superintendent of bridges and buildings to the division superintendent. These are filed in the chief engineer's office.

4. There is also an inspection made in April by the superintendent of bridges and buildings.

5. The object of the September inspection is to determine the condition of the structures and the necessity for repairs or renewals or replacement by permanent structures.

6. On the September inspection the division engineer and superintendent of bridges and buildings go on a hand car and carry the necessary complement of tools to make the inspection. The general inspectors have gasoline motor cars and carry augers, bars, etc.

7. The track department looks after matters of inspection in a very general way. They are supposed to report anything they see in the way of obstructions in the streams and clean off bridge seats, etc.

8. Culverts should be inspected by the bridge department.

9. All openings under the track that break the continuity of the road-bed are called bridges, regardless of their length.

10. The masonry and foundations of bridges are inspected on this road at the annual fall inspection by the engineering department and superintendent of bridges and buildings.

11. There is a bridge engineer reporting to the chief engineer and has charge of making of plans for permanent work and standards for both permanent and temporary work. All new construction is carried out on each division by the engineering department. On each division there is a superintendent of bridges and buildings who has charge of the maintenance of bridges and buildings and reports to the division superintendent.

I enclose blanks used in reporting on bridge and culvert inspections and instructions to the inspectors.

Note by Committee.—The inspection forms are similar to typical form "E," issued in book form, 4½ x 10 inches, for field use, and in separate sheets, 8½ x 13½ inches, for office use, excepting the two columns headed bridge number and item number, as shown on form "E," are omitted. The bridge number and item are written by hand under the remarks column if any special note is to be made for same. Instructions and regulations are printed in the front of each book.

C. A. Lichty, Superintendent Bridges and Buildings, Chicago & North Western Railway:

Our regular inspection book, form No. 715, is bound in book form, with one hundred leaves, each leaf having space to report six bridges; the opposite page is for notes.

The instructions are bound in front part of each book. This book form 715 is known as inspection book.

Form 728 is the report sheet, which is filled out similar to inspection book, and copy furnished general superintendent and chief engineer after copying into tissue books. The superintendent of bridges and buildings makes out one report in inspection book and writes up one book of inspection and the division engineer does the same.

The superintendent of bridges and buildings makes estimates for

renewals and repairs of wooden structures; the division engineer for permanent work.

In reply to questions :

1. See instructions in book form 715.

2. This company has a general bridge inspector and an assistant. Each of these two men must go over the entire system once a year or oftener (not at the same time), and compare notes made in regular inspection by the superintendent of bridges and buildings and division engineer and any additional notes he sees fit.

3. See instructions, form 715.

4. No.

6. Inspection is made on motor car, with superintendent of bridges and buildings, division engineer and bridge foreman (in his own territory); or if motor car not available, they are conducted over the division on regular hand car by the regular bridge crew, in whose territory inspection is taking place. A seat fastened on front of car for two men. Tools carried: Sharp bar for prodding timbers; auger for testing timbers; shovel.

7. Only when they notice something wrong. They are instructed to examine each bridge carefully after heavy rains and freshets, while going over their track.

8. Yes. It is the rule with this company.

9. Sixteen feet.

10. Should be looked after same as any other subject. In special cases, or cases of great importance, this is done by engineering department.

11. 1. Bridge engineer for entire system.
2. General bridge inspector, assistant general bridge inspector for entire system.
3. Superintendent of bridges and buildings and division engineer, one division only.
4. As many bridge crews under the superintendent of bridges and buildings as necessary for wood work.
As many bridge crews under the division engineer as necessary for permanent work.

Superintendent bridges and buildings reports to division superintendent.

Division engineer reports to chief engineer.

M. Riney, Superintendent Bridges and Buildings, Chicago & North Western Railway:

1. General inspection is held in September and April. In September by the division engineer and superintendent of bridges and buildings and in April by the superintendent of bridges and buildings.

2. Yes. Two general bridge inspectors.

3. Division foreman and superintendent of bridges and buildings make frequent inspections of all openings and trusses. Bridges over eight years old, if any defects are discovered, repairs are made and if they exceed $25 an order is asked for and given for such repairs.

4. After heavy rain storms division foremen and section foremen inspect all openings and report on all that are damaged.

5. Piling, ties, stringers, caps, all foundations.

6. Hand car with four men. Auger, bar, shovel, and steel prod.

7. High water on all stone and timber culverts and all piers and abutments.

8. Yes.

9. Twelve inch cast iron pipe.

10. See instructions Nos. 19, 20, 21, 22, and 23.

11. Foreman has about 84 miles of road to repair bridges, platforms, and stock yards; has one tool car for a crew of six to ten men, push car and hand car. When we have special work, working force is engaged to assist on the subdivisions, the regular crews assigned to those divisions.

C. W. Kelly, Superintendent Bridges and Buildings, Chicago & North Western Railway:

1. Two inspections per year. Spring inspection, beginning in April, made by the superintendent of bridges and buildings in company with his bridge foremen, and all notations made on form enclosed. Form enclosed should show the division upon which inspection is made and between what two consecutive towns the bridges occur, and should be signed and dated by the officer making the inspection. You will notice that most all members of the different character of bridges are mentioned in this report; there is also one full blank page for notes; in addition to this it is usually customary to carry a side note book that more extensive notes may be had. This book is then written up, placed in the offices of the division engineer and superintendent of bridges and buildings and a thorough report made by letter to the superintendent of the division by the bridge and building superintendent, and to the chief engineer by the division engineer.

2. The North Western system has a general inspector of bridges and an assistant general inspector of bridges whose duty it is to visit all permanent work at least once a year, making report to chief engineer on blanks furnished by the chief engineer. It is also the duty of these officials to make any special examinations and reports of bridges which may be deemed necessary.

3. Semi-annual reports. Spring inspection in April by superintendent of bridges and buildings and bridge foremen, on report blanks same as per question No. 1. Fall inspection in September by superintendent of bridges and buildings, division engineer, and bridge foremen, on the same reports. These reports are handled the same as explained in answer to question No. 1.

4. There is not.

5. All points mentioned in printed report together with any general conditions or special conditions that may be suggested to the inspector.

6. Inspection is made in springtime on gasoline car. In fall inspection generally on ball-bearing hand car pumped by bridgemen. Tools employed are testing hammer for iron bridges and prodding bar for ties, guard rail, and piling; also a shovel is employed to dig the surface ground from around piling, but this procedure usually takes place some few days before inspection is made by bridge forces in order to save time.

7. It is their duty to report any irregularity they may notice. They are not, however, assigned to any duties of inspection, except to report heavey bridges or bridges out of line that may have escaped the notice of the superintendent of bridges and buildings or bridge foremen. Section forces are not used even in pumping hand car for bridge inspection.

8. They should, in order that the bridge department may be kept fully advised as to the drainage area, the quantity of flow and velocity of flow. The equalization of water on both sides of the embankment. The waterways, however, are kept cleaned through culverts and pipes by road forces.

9. Any opening to the surface of track more than two feet in width is assigned bridge number and given attention as a bridge. Any tile or waterway six inches or larger is given attention by the bridge department.

10. To an extent to ascertain whether or not it is settling or cracking, shelling or capping; whether or not it needs pointing, the condition of its bridge seats and pedestal stones, and condition of back walls.

11. Bridge department on the North Western road is divided into two departments. The construction department covering all permanent structures, under the direct charge of the chief engineer, and handled on the division by the division engineer. The construction, maintenance, and operation of bridges under the division superintendent, directly handled by the superintendent of bridges and buildings. The territory assigned to bridge forces varies from seventy-five to one hundred miles per crew of foreman and four men, each supplied with a kit of bridge tools and tool car, one hand car, and a push car.

A. W. Merrick, Division Engineer, Chicago & North Western Railway:

1. There is a general bridge inspector and an assistant general bridge inspector for the entire road who report to and receive instructions from the chief engineer. It is their duty to make examinations and report on all important structures several times each year. The bridge crews, under the charge of superintendent of bridges and buildings of each division, are relied upon to report all necessary repairs which may require attention between the regular spring and fall inspection.

2. See reply to No. 1.

3. Two regular inspections are made each year. One in the month of April by the superintendent of bridges and buildings on each division, of all truss and trestle bridges. The result of this inspection is reported to the division superintendent and division engineer, who in turn report to the general superintendent and chief engineer respectively. The other and more comprehensive inspection is made in the month of September jointly by the division engineer and superintent of bridges and buildings of each division. This inspection contemplates an examination of all bridges, culverts, and waterways and is made with special reference to obtaining data for estimating cost of renewals and repairs for the ensuing year. The report of this inspection is sent by the division engineer to the chief engineer and the report of the superintendent of bridges and buildings is sent to the division superintendent.

All inspection notes are entered in the standard form of bridge in-

spection book. The superintendent of bridges and buildings and division engineer each keep separate records. A copy is sent you herewith and in connection with this will say that we generally arrange to have each bridge number entered in the book, as well as the first five items pertaining to each one, before starting on inspection. This saves time in the field and prevents omissions.

4. No, sir.

5. The copy of our report blank herewith indicates that the inspection covers all important details of each class of structures.

6. Inspection is generally made with gasoline motor car carrying three men; the division engineer, superintendent of bridges and buildings, and the bridge foreman over his subdivision. A light bar and an auger are the usual tools employed.

7. Section men are expected to report any unusual or bad conditions which may come under their observation.

8. Yes, sir, to the extent indicated in the first paragraph of No. 3 and last paragraph of No. 1.

9. Each opening, with the exception of cattle-guards and track boxes, is given a number and classed under the head of bridges.

10. The condition of masonry is inspected each spring and fall as indicated in paragraph No. 3. A critical examination should be made at these times of ring and covering stone and paving of arches and stone boxes; all piers and abutments, noting cracks and necessity for pointing; all foundations as far as possible, noting requirements as to riprap or other protection, change of channel in stream, etc.

11. All permanent bridge work is in charge of the engineering department, the work on each division being in charge of the division engineer, who reports to the chief engineer or the principal assistant engineer. All repairs and rebuilding is done by the superintendent of bridges and buildings, who reports to the division superintendent. All standard bridge drawings and plans for permanent work are made by the engineering department. The division engineer and the superintendent of bridges and buildings maintain their own separate bridge crews.

Benjamin Douglas, Bridge Engineer, Michigan Central Railroad:

1. Our bridges are inspected twice a year by assistant bridge engineers, once or twice by bridge foremen, and once by the bridge engineer accompanied by assistant engineer and foreman. More frequent inspections are made of structures which seem to need special care.

I cannot very well send you a specimen of report blanks. We have note books containing complete lists of all bridges and culverts, every other page being left blank for notes on the condition of bridges on the page facing it. If the condition of bridge is such that the notes will take up more space than it is desirable to use on the blank page, special report is made on separate piece of paper and note to that effect entered in the book.

2. No.

3. The reports are sent to the bridge engineer for such action as he may see fit to take, and filed in his office.

4. No.

5. Inspector is expected to make a thorough examination of all parts of the bridge, and to be sufficiently intelligent to decide for

himself what points need special examination, subject, of course, to general instructions by the bridge engineer.

6. Inspector goes over the road on a gasoline motor car, carrying with him an axe, brace and bit, and light bar.

7. Section foremen and roadmasters are expected to watch bridges for indications of damage by fire or flood, and also to note any defect in alignment or surface.

8. Yes.

9. We have no limit. All openings are considered as bridges.

10. Bridge department should have full charge of maintenance of masonry and foundations. They should be inspected the same as other parts of the bridge.

11. Our bridge department consists of a bridge engineer, a number of assistant engineers and draughtsmen, some of whom do office work only, and some both office and outside work. It has full charge of both maintenance and construction of all bridges and culverts. Practically all construction repairs are made by the forces of the company, almost no work being done by contract.

E. B. Cushing, Engineer Maintenance of Way, Galveston, Harrisburg & San Antonio Railway:

1. Under our organization superintendents of bridges have charge of about 500 miles of track. They are required to personally inspect each bridge on their division twice a year. Their division foremen, who have charge of the bridges on about 100 miles of track, make an inspection and report every three months.

2. We do not keep a bridge inspector.

3. Answer to question No. 1 will apply to this, would say further that the quarterly reports are examined by the resident engineer, superintendent, and ultimately by either the engineer maintenance of way or the assistant engineer maintenance of way.

4. Nothing special to recommend.

5. See reverse side of enclosed blank (W-19).

6. See instructions on blank W-19. Inspections made on a light hand car handled by four men. The inspector carries with him an auger, hammer, and steel bar with one end pointed, the other end chiseled; also carry wrenches to use by the men tightening bolts, while the inspector is engaged on trestles of any length.

7. No dependence is placed on the bridge department for inspection of bridges beyond acting on information given by section foremen that bridges need attention.

8. Yes sir.

9. We place a bridge number of every drainage way through the track. We only call iron structures bridges, referring for the sake of distinction to all wooden bridges as trestles, and any openings other than culverts are classed as bridges.

10. The bridge department should make full inspection of masonry and foundation to bridges.

11. Our organization beginning with the minor positions is, gang foreman, superintendent of bridges and buildings, resident engineer, division superintendent, engineer maintenance of way, and general

manager. There is a bridge engineer, who is connected directly with the Southern Pacific Lines West of El Paso, with whom we confer on matters relating to extensive renewals of iron structures only.

Note by Committee.—The report blank is the same as the Southern Pacific for truss bridges, a single sheet, 17x14 inches, same as typical form "F."

F. S. Edinger, General Bridge Inspector, Southern Pacific Company (Mr. Edinger's answer concurred in by John D. Isaacs, Assistant Engineer Maintenance of Way, Southern Pacific):

The methods in use on the Pacific System of the Southern Pacific Company's lines, are as follows:

1. Three quarterly inspections are made by the resident engineer or his asistant on all structures on his division.

An annual inspection is made by the general bridge inspector or his assistant, accompanied by the resident engineer or his assistant, which answers for the fourth quarterly resident engineer's inspection as well as general bridge inspector's annual inspection.

The report blanks used for the above inspections are form 2-W-23, (specimen herewith) for reports on trestles, and form W-19 (specimen herewith), for reports on truss bridges. Reports are made in duplicate, one copy being retained by the resident engineer and one copy being sent to the office of the engineer of maintenance of way.

2. Regular bridge inspector for annual inspection. Quarterly inspection made by the resident engineer's assistant in charge of the division bridges and buildings.

3. Answered under question 1.

4. No other special class of bridge inspection that I would recommend.

5. See printed instructions on back of form W-19.

6. Inspection is made by man in charge of inspection accompanied by as many men as he deems necessary to assist in uncovering piles, boring, etc., traveling on gasoline motor car and carrying tools with him, consisting of boring tools, bars pointed on one end for prodding decayed piles, with a heavy knob on opposite end for sounding timber, and a hatchet or other tools which he may require. Piles not standing in water are usually uncovered to a depth of 18 or 20 inches below the natural surface in advance of the inspector by the section men and covered in again after inspection has been made.

7. Roadmasters, section foremen, and track walkers are also required to examine all structures on their respective districts, but are not required to report excepting in case of failure or defects being discovered.

8. Culverts should be inspected by bridge department as well as by track forces.

9. We have no limiting conditions or length for the term "bridge, viaduct, trestle, culvert or opening," though usually openings spanned by trusses or single girders of 20 feet or over are termed "bridges." A series of girders on steel bents is termed a "viaduct." A span under 20 feet, with no intermediate bents, is called an "opening," usually prefixed by length of span, such as "16 feet opening," "5 feet opening," etc. Timber structures without trusses, supported by one or more intermediate bents are termed "trestles."

The term "culvert" being applied to openings entirely buried under the road-bed.

10. The masonry and foundation of bridges should be inspected by the bridge department.

11. All bridge reconstruction and renewal comes under the general supervision of the maintenance of way department of the various systems, constituting the Southern Pacific Company; these general officers being engineer of maintenance of way, engineer of bridges and general bridge inspector. The actual work in the field is executed by the resident engineer and engineer's assistant on each division; these officers representing the maintenance of way department and executing the work in accordance with instructions received from the general officers of this department.

Note by Committee.—The form for truss bridges is a single sheet, 17x14 inches, as presented in typical form "F." The form for trestle bridges is a single sheet, 4½x7½ inches in pads, similar to typical form "F," with special columns for noting conditions of each pile, post, cap, stringer, etc., of any particular bent.

F. Ingalls, Supervisor Bridges and Buildings, Northern Pacific Railway:

1. Blanks enclosed covering information asked for.

2. Yes; and in addition to inspecting bridges and waterways, also inspects buildings to see if proper precautions are taken to protect same from fire. List enclosed of points covered by such inspection. He also inspects and keeps mail cranes and train order signals in proper adjustment, and reports on anything else he may notice regarding buildings or platforms that require attention.

3. Blanks enclosed covering information asked for.

4. None, except that from time to time we have a special inspection made of iron bridges for loose rivets and other defects that regular inspector is unable to make.

5. Points covered by regular inspection shown on enclosed leaves from note book. The inspector covers the same points, only makes no report except of such matters as he cannot remedy himself and that require early or immediate attention.

6. Regular inspection made by train. Inspector uses velocipede car and carries only a few small tools such as can be put in a lineman's grip.

7. But very little, except in times of freshets or high water, and that Book of Rules calls for them to note condition of all waterways and report any defects they may discover. For general condition of bridges I depend on regular bridge inspections.

8. Yes, at least once each year, as there might be defects not noticed by trackmen.

9. We have no rule governing. All openings to tracks are numbered same as bridges, but it is customary for us to designate all openings of 12 feet or less as culverts.

10. To such an extent as to insure safety of structures and to discover any changes or defects.

11. My division, while covering 700 miles, has only 200 miles of main line. The bridge crews have from eight to twelve men, under a

foreman who reports direct to the supervisor. On large jobs the number of men is increased as may be necessary. Small jobs, requiring from two to three men, are handled by detachments made by the foreman from the regular crews.

Note by Committee.—The inspection report is in book form, 5¼ x 9½ inches, similar to typical form "F," with separate office sheets 8½ x 14 inches.

J. P. Carpenter, Supervisor Bridges and Buildings, Southern Railway:

In making annual inspection trips it is best, first to have one of the heaviest engines in use on the road. The inspection party should consist of the chief engineer or his assistant or both, and one of their employees, with a good level and extension rod, the man in general charge of the bridges, the superintendent or supervisor of bridges and buildings, one or more good all-round bridge men with light hand hammers, a good crank auger or two, a steel pinch bar, an axe, and one small and one large monkey wrench; the roadmaster should also be along as there will in all probability be enough to interest him. The work should be outlined as follows:

All metal structures, especially spans, should have the abutments and piers examined with the level and rod to show what deflection, if any, occurs while engine is run over it, both at a slow and a high rate of speed. The deflection of the centers of all spans should also be taken and noted, with engine and train crossing. If the metal work has been gone over and loose rivets replaced and the metal painted within two years or so, I would not allow a hammer used on the rivets. A loose rivet will speak for itself on a coat of paint two years old. Then the pin nuts, if any, should be examined (without a hammer) to see if working loose, and all adjustable rods should be well looked over, and in such cases the large monkey wrench will be found useful in taking up slack of rods, temporarily at least. If the metal has not been painted and loose rivets replaced within two years or so, each rivet should be examined and number and location of loose ones noted. The same process will apply in general to metal viaducts, especially as to loose rivets, nuts, and adjustable rods. Adjustable rods not only get too loose but it is a very easy matter for them to be made too tight and distort the members of a viaduct.

When we find an old Howe truss or combination span, I look well to the condition of all wooden members, and when it seems advisable to do so, I bore into them and note the per cent. of good wood remaining on such spans; the deflection of span and its bearing should also be carefully noted with the level under weight of the train. We sometimes find in taking deflections in this manner that the span or its bearings will be found to move in a horizontal as well as a vertical direction, indicating that some member in one truss is not as rigid as in the other truss, or that one end of a pier or abutment may be undermined, or other trouble may develop.

In inspecting frame or pile trestles the crank auger, steel bar, or an axe come in for their part of the work in detecting defective posts, sills, and other members.

As to form of report to be made of such inspection, I have never yet seen a form that was comprehensive and brief enough to be shown on one sheet of paper of practical and useful dimensions, and I think in most cases no man could fill out one of the blanks commonly used intelligently but the man who got up the form. To my mind a neat typewritten report, made up from minute notes taken on the ground at each structure, is far more comprehensive and comparable with former or later reports of same kind, than any form that can be made.

As to inspecting stone, brick, concrete, or pipe culverts, there should be very minute notes made of any defect that may be found, and quantities of material required for repairs. In each case a large-sized kodak should be used and a view taken of both ends of each culvert, whether defective or not, and a copy of each view should accompany the report.

R. H. Reid, General Bridge Foreman, Lake Shore & Michigan Southern Railway:

1. Our bridges and culverts are inspected weekly by the section foremen, who report to the roadmaster; monthly by the roadmaster, who reports to the principal assistant engineer; semi-annually by the bridge inspector, who reports to the general bridge foreman; and annually by the general bridge foreman, who makes out all the working orders, bills of material, shipping bills, etc.

There is no regular form of report except by the roadmaster to the principal assistant engineer, who reports that he has examined all bridges and culverts on his division, and finds all in good condition except, ... stating what he finds against each one in detail. These reports are referred to the general bridge foreman who looks up the matters in question on the annual bridge inspection, unless earlier attention is necessary.

2. We have a regular bridge inspector for the semi-annual inspection of bridges.

3. See answer to No. 1.

4. Special inspection is made of bridges whenever necessary, on account of fire, accident, large increase in loading, or age of structure.

5. Condition of piles and timber in timber structures, also line and surface, strength of stringers, adjustment of bolts, etc.

In iron structures, line, surface, adjustment, rivets, pins, rollers, ties, strength, masonry, and, in fact, everything.

6. By bridge inspector on velocipede car, using ¼-inch inspection auger and pointed steel bar; roadmaster and section foremen, using no tools, get over the road on hand car; general bridge foreman uses auger and bar, and hand car with seat across front.

7. Only for fires, accidents, and other defects which are *plainly evident* to the inexperienced, and which may occur between the semi-annual inspections by the inspector.

8. Yes; unless some other department is responsible for them.

9. A bridge is any structure where the track is carried by any kind of beam (stringer, girder, or truss), regardless of length; a culvert is any structure carrying an embankment over it (arch, box, pipe, etc.).

10. Masonry and foundations of bridges should be inspected for all defects the same as bridges, unless inspected and maintained by some other department.

11. General bridge foreman, bridge inspector, draftsmen, clerks, bridge foremen, and bridge men.

I enclose herewith sample sheets of my inspection book and bridge record, with some explanation of them. The record is written on the record pages, and each alternate sheet is ruled for inspection notes, the whole being bound in a loose leaf cover, so that the inspection pages can be removed and filed, after the repairs and renewals have been ordered, and new pages substituted for them. This minimizes

the work required to keep a book up to date and accurate, so that I keep this book up myself.

Note by Committee.—The inspection notes are recorded, on blank loose leaves, 4 ¼ x 7 inches, fitting into a patent book file.

B. W. Guppy, Bridge Engineer, Maine Central Railroad:

1. Monthly inspection under direction of superintendent bridges and buildings by members of the bridge crews. Reported to chief engineer on form "A" enclosed herewith.

2. No. Inspection made as answered for No. 1.

3. Semi-annual inspections are made by the inspector reporting to the bridge engineer of all bridges, open culverts, and arch culverts and the results are entered in field books ruled like form "B" enclosed herewith. These books are sent to the bridge engineer. The reports are compared with the previous ones, any changes are noted in the records, and the books are filed in the plan vault. The books are not sent in to the office until they are filled but if the inspector finds anything requiring immediate attention he sends a special report to the bridge engineer.

4. Certain light bridges and some special defects are subjected to more frequent examinations.

5. The monthly inspections are to see that everything is in a safe condition. The semi-annual inspections are for the purpose of noteing all defects and ascertaining if any changes are taking place.

6. By velocipede car or walking between stations. Hammer and small bar.

7. Trackmen make casual inspection of bridges each day when going over section.

8. Culverts are inspected by track men whose business is to keep them open and report anything wrong.

9. Twenty feet clear space for monthly reports. The state railroad commissioners require a record of everything over 6 feet clear.

10. The inspectors are required to examine and report on condition of masonry as well as the superstructure of all bridges. Occasionally a diver is employed to examine the work under water.

11. Chief engineer, bridge engineer, inspector, superintendent bridges and buildings, foremen bridge crews, foremen of carpenters, assistant engineer, foremen of masons, resident engineer, contract work, foremen painters.

The bridge engineer prepares plans and specifications for all new bridge work (both superstructure and substructure) and has a general supervision over the construction. Keeps records of the strength and condition of all bridges. Assists architect with the structural details of building work.

The superintendent of bridges and buildings has charge of the maintenance of bridges and culverts and the erection of new work.

The assistant engineer has charge of the mason crews regularly employed in building culverts, turn-table and scale pits, machinery foundations and small abutments and retaining walls.

Large jobs of masonry are built by contract. Steel bridges are built by contract from detail designs furnished by the railroad company and are erected by the railroad company.

Note by Committee.—The monthly inspection form consists of a pamphlet, 8½ x 14 inches, with bridge numbers and name printed on left side of each page and then blank columns, headed,—date, iron and woodwork, masonry, for noting general conditions. The form for semi-annual inspections is issued in book form, 4¾ x 7½ inches, and has down left side of each double page printed headings such as date, division, mile, name, span, sundry, especially enumerated bridge parts, recommendations, inspector. The balance of the double page is divided in vertical columns, one column for each bridge.

D. C. Zook, Master Carpenter, Pittsburgh, Fort Wayne & Chicago Railroad (Pennsylvania Company):

I enclose form of blank we use in making our report to the superintendent and the chief engineer. Together with a copy of instructions for the inspection of bridges. These instructions will answer the principal parts of your questions.

2. We do not keep a regular bridge inspector.

4. We have always found our system of bridge inspection satisfactory and do not know how to improve upon it.

6. Our inspection is usually made on a hand car propelled by four of our bridge carpenters, who assist in making inspection of the different members of bridges. The tools we use are sounding hammers and pointed steel bar about four feet long.

11. An outline of the organization of the bridge department is as follows: The western division consists of 256 miles of road, the principal part being double tracked. We have a master carpenter as head of the department with two bridge foremen and two assistant foremen. We have at present in our employ twenty bridge carpenters and four helpers. The road is divided into two carpenter divisions under the bridge foremen who work under the instructions of the master carpenter. In addition to taking care of the bridges they also take care of the buildings. We have no special building gang. In erecting steel bridges we contract with bridge companies for the erection of all structures over 50 feet span, less than that we erect ourselves.

Note by Committee.—The field inspection reports are issued in book form, 5 x 8¼ inches, similar to typical form "E." There is an office report sheet, 16 x 14 inches, similar to typical form "F," on the left side of which is a printed bridge list with bridge data.

F. E. Schall, Bridge Engineer, Lehigh Valley Railroad:

1. An inspector is employed for each division, going over the bridges and structures continually from one point to another, as necessities may arise or the character of any structure may demand. They report daily to the supervisor of bridges. These daily reports are compiled in monthly inspection reports by the division engineer, and sent to the division superintendent, engineer of maintenance of way, and bridge engineer.

2. Yes.

3. All bridges are inspected by the bridge engineer annually in the fall of the year; he is accompanied by the division engineer, supervisor of bridges, and bridge inspector. No special report blank is used; each structure inspected is mentioned separately and the condition briefly stated. The reports are sent to the chief engineer, and

engineer of maintenance of way, and by them submitted to the general manager and division superintendent respectively.

4. No, except for special cases which should be provided and arranged for specially.

5. Current inspection. Bridge inspector examines every bridge and structure in detail under instructions furnished him.
Annual inspection. The inspection by bridge engineer is more of a general nature except in special cases pointed out to him by the bridge inspector or division engineer, when detail inspection is made. This inspection is also for the purpose of ascertaining what changes and renewals should be provided for during next working season.

6. Inspector goes by train or foot, depending largely on the location of the structures to be inspected. He carries the following tools: broom, wrench, spear, ¼-inch auger or brace and bit, inspector's hammer, ¼ dozen standard floor-bolt nuts, red chalk, black chalk, foot rule, calipers, and report blanks, to enable him to make minor repairs, adjustment of nuts, bolts, etc.

7. None, except in cases of washouts, derailments, etc., when track department will step in and make such minor or temporary repairs as they can or as are necessary for safety of trains, reporting by telegraph to the division engineer and superintendent.

8. Yes.

9. Five feet clear.

10. Surface inspection, bulging or deformation only. Inspection of foundation should be made through engineering department.

11. Bridge engineer reporting to chief engineer. Supervisor of bridges and buildings, each division reporting to division engineer. Foreman carpenter, foreman mason, bridge inspector, each reporting to supervisor of bridges and buildings.

Note by Committee.—The daily report form for current inspection used by the division bridge inspector is similar to recommended form "A." The monthly report form, being an office compilation of the daily reports, with notes added by the division engineer, is similar to recommended form "B." The bridge engineer, on the annual inspection, makes notes at each bridge in a blank book and subsequently prepares a typewritten report.

R. L. Heflin, Supervisor Bridges and Buildings, Lehigh Valley Railroad:

1. My bridges are inspected by one man appointed for that purpose and he goes over the entire division of 350 miles and about the same number of bridges three times, sometimes four times, per year.

2. I keep a man regularly for current inspection.

3. We have an annual inspection made by the engineer of bridges, division engineer, superintendent of bridges and buildings, bridge inspector, and bridge foreman, over whose territory we inspect.

4. I cannot suggest any better arrangement than practised by us.

5. Everything is carefully inspected. Rivets, whether loose, angles, crooked or otherwise. Rods of all descriptions, whether properly adjusted. Condition of ties, guard rails, wall plate, mud sills, or anything of wood or iron. Paint, masonry, in fact everything pertaining to a bridge.

6. The inspector goes over the road on a three-wheel velocipede. He carries a small hammer, brace and bits, and wrench.

7. Only to the extent that anything happens out of the usual wear and tear. They report same and it is looked after by the superintendent of bridges and buildings.

8. The culverts are not closely inspected by the current inspector. When repairs are found wanting the track department reports same and the superintendent of bridges and buildings investigates and has proper repairs made.

9. Minimum opening four feet.

10. To the fullest extent.

11. I have two bridge and building foremen, who have two assistants; also one foreman mason. When a piece of work is to be done the foreman is notified and given directions. We then send out the material and men as the case may require.

J. H. Markley, Master Bridges and Buildings, Toledo, Peoria & Western Railway:

1. The current inspection of bridges is made as the condition of the structures demands it. When the annual inspection is made the condition of all structures is carefully noted, and the condition of those demanding it are inspected at intervals of thirty to sixty days.

2. I keep no regular bridge inspector for the current inspection of bridges.

4. No, sir, there is no other class of bridge inspection that I use or could recommend.

5. When inspecting pile trestles, I examine the piling very carefully, especially at the ground line. In my experience I find that the defect is most always found there. Caps decay, mostly, directly under the stringers where they hold the moisture. Stringer defects are most always found at the ends. In my experience I find that decay takes place there first. I find more defects in pile trestles, including the deck, by a very careful inspection from under the bridge. In pin-connected steel trusses, a very careful inspection is made to detect loose rivets. These defects, however, are seldom found. Close attention should be given to the slacking of the turn buckles on the counters and lateral rods. Nuts on all the pins and the turnings of the pins is a very serious defect.

3 and 6. I have no regular time for the purpose of making quarterly or semi-annual inspections. I make a general inspection of every structure once a year. The condition of all of them is carefully recorded in a book that I carry with me on the trip. I have no regular inspection blank forms. I have always used the blank book and by this method there is little or no danger of losing the inspection record. From this record the orders are issued to the foreman, with the bill of material needed. All of my inspection books are carefully kept, so that when it becomes necessary to renew, for instance, a pile bridge I can refer to the previous bill which gives the length of piling in each bent. When I make the regular annual inspection, I take two of my best bridge men with me on a gasoline motor car. We carry one diamond point bar, made of ¾-inch hexagon steel, 3 feet 6 inches long, one shovel, brace and bits.

7. I do not depend on the track department for the inspection of any bridge or culvert. If it is a charge of mine and I am held re-

sponsible for it, I want to know its condition by a personal inspection.

8. If the culverts are a charge of the bridge department, they should look after them just the same as they do any other structure that they build and maintain.

9. I class all structures that have ties on them as a bridge. The shortest one I have, however, is ten feet. All under this length are either piped or made into rail and concrete culverts.

10. I hold the same answer for this question as I do for the 8th.

11. The organization of the bridge department of this road is rather peculiar compared to that of any other. From its force, men are drawn to run the steam shovel and pile driver engines. Should repairs be needed for the machinery or boilers, the same force makes all of these repairs. The most peculiar part, however, is manifested in the stone gang. These stone cutters and masons are men who make up a portion of our regular bridge and building force. When the season is at hand for stone work they lay down bridge and building tools for those used in the stone work. Their wages are advanced to that usually paid for that class of work. When the stone work season is over they again appear as regular bridge and building carpenters, and work at carpenters' rate of pay.

J. B. Sheldon, Supervisor of Bridges, New York, New Haven & Hartford Railroad:

1. No clearly defined system. Inspection made at option of supervisor. Usually by himself. No report blanks.

2. Do not.

3. Reports made to division engineer on such bridges as are in need of repairs or renewals. No blanks for reports.

4. It should be careful and thorough.

5. No classified inspection. Inspection is general.

6. Inspection usually made on velocipede car. Should have a hammer, chisel, and auger or bit.

7. Only cursory examination.

8. Usually inspected by bridge department.

9. Ten feet.

10. Masonry and foundations are classed as bridge work and inspected by bridge department.

11. First, supervisor reports to the principal assistant engineer of a district, who in turn reports to chief engineer, the chief engineer reporting to the fourth vice-president, who is in charge of maintenance of way.

A. E. Killam, Inspector of Bridges and Buildings, Intercolonial Railway of Canada:

1. The entire system of 1,400 miles on the main line, (P. E. I. left out) once a year is inspected by the bridge and building inspector. Starting at Ste Rosalie, the junction with Grand Trunk Railway, personally inspecting everything outside of the cattle-guards, as indicated by the sheets sent, culverts of all kinds, box, pipe, iron, beam

culverts, and bridges in every part, substructures and superstructures, and stations, as they are reached, commencing at No. 1, be it culvert or bridge, 2, 3, and upwards until the next station is reached, putting down the name of the station, then going on again in the same manner as before stated. The inspector's notes on I. C. R. bridges and culverts filled 125 large pages, as per sample sheet.

2. Yes, a regular bridge and building inspector is kept.

3. The inspector starts at the western end of the line junction with the G. T. Railway at Ste Rosalie as early in the season as is possible, and proceeds continuously easterly over the line, structure to structure until all the line and its branches have been gone over to the end of the line. Instructions have been given to the section foremen to keep a watch for defects that may appear between times. If the inspector finds anything that needs immediate attention the facts are reported to the engineer of maintenance. If the defects are in the steel bridges, the bridge repair crew is sent to make repairs. If in the masonry work the mason crews are sent to make repairs, and if in the woodwork, then the trackmaster is instructed to send his carpenter. If the section foreman finds anything wrong, he reports to the trackmaster, and the trackmaster to the engineer of maintenance, who often instructs the inspector to visit the structure again to examine and report again if the examination results in an expenditure of anything like a considerable sum. A copy of the inspector's report is referred by the engineer of maintenance to the general manager. If not serious, then it remains with the engineer.

4. I have given this matter much consideration for years, and have come to the conclusion that the only safe and proper way is for the inspector to see everything within the bounds of the railway from the top of the roundhouse and station house to the foundation thereof and the bottom of the cellars, and from the top of the bridge to the bottom of the foundation as near as possible. When our bridges are in deep water, we employ marine divers to go down and examine all below the water, be it masonry or piling. In 1898 some of the bridges were thought to have more deflection than they should have, as was reported by the engine drivers on several bridges along the line, so the inspector got up a special machine and tested all the bridges of 40 feet span and upwards between Halifax and Levis, 674 miles, tested both chords in the centre of the spans, recording the same, and then again in 1900 tested some of the doubtful spans to find the deterioration, with a view of strengthening and putting in new spans on the older sections of the road.

5. This has been quite fully answered in Nos. 3 and 4, but would here say that this depends on class of the structure. All the riveted sections of steel structures are closely scrutinized and sounded with a light hammer, a man passing along on both sides of the structure, and the inspector watching and recording the result. The masonry is carefully examined, and the result recorded whether it needs pointing or other repairs are needed.

6. The inspector has one assistant on whom he can depend, and sometimes goes along the line with him on a motor car, and sometimes with the section men on hand car, stopping at every structure of whatever kind it may be, culvert, bridge, or station, or other building whatsoever, having book, pencil, testing hammer, etc.

7. None, only as to intermediate reports from section foremen through the trackmaster.

8. I think so, as by our mode it involves no extra expense. It is consecutive, and the report being mixed and numbered consecutive, and each division one after the other noted, and the mile posts numbered, any culvert or bridge can be found and its exact locality settled in an instant.

9. Up to 12 feet we call beam culvert, above that length bridges.

10. The inspector of bridges and buildings inspects once a year, and at other times when reports are received from any one of the trackmasters that he seems to think that something is wrong.

11. The Intercolonial Railway Engineering Department, Management of Improvement and Maintenance, is in two departments. First, there is the improvement department, managed by the chief engineer, Mr. W. B. MacKenzie, who has charge of all new work, constructed out of capital expenditure, such as large new bridges, new roundhouses, and large new stations, and terminal facilities, wharves, and ferries constructed out of capital, etc. Second, the maintenance department is under Mr. T. C. Burpee, engineer of maintenance, who has charge of all matters in connection with the maintenance of the railway, paid out of revenue. Under the engineer of maintenance there are 13 trackmasters, whose divisions are from 78 to 130 miles long for 13 divisions of the road. These divisions are divided into sections of 5 to 6½ miles with a section foreman, and two men with him in the winter season, and three and four in summer season as the case requires, with much larger crews to put under the track any new ballast, distributed on various sections of the road from time to time during the summer season. The regular section men put in all new ties, switches, etc. We have two bridge gangs with office and boarding car to accommodate from 12 to 15 men with all the necessary outfit for lifting, repairing old spans, putting in new spans, erecting, etc., who are at the disposal of the chief engineer of construction, or the engineer of maintenance as needs be at any point along the line, so you see the bridge department is in with and a part of capital construction as well as that of maintenance. There are not many forms of bridge reports. Reports are mostly made by letter. However, I send you a book of rules for the track maintenance department; also the new form before referred to, gotten up by the inspector in 1898 and filled in in 1900 from personal inspection notes taken along the line, from end to end thereof; also I send trackmaster's form for material wanted for his division. I also send a copy of the new form of culvert and bridge record, which is to be put in use in the near future, after the new bridges are all in in 1903 and 1904. The Intercolonial has 3,541 structures, including culverts, bridges, etc., or 4,152 spans outside of open cattle-guards, and after the new bridges are all in this new form will be put in use. There will be a book for each division, and about 400 leaves in each book.

Note by Committee.—The inspection form is a single sheet, 18x14 inches, similar to recommended form "C." On the left side are 18 vertical columns for bridge data (practically bridge record sheet), and the balance of sheet left blank for date of inspection and remarks under which the condition is noted. The new report forms are similar, but have spaces for filling out more complete and detail bridge data.

C. N. Monsarrat, Engineer of Bridges, Canadian Pacific Railway:

The Canadian Pacific field inspection book is shown by the typical form "E," size of book, 5¼x9¾ inches. The printed instructions in

the front of each book, issued by Mr. E. H. McHenry, chief engineer, September 1, 1902, follow generally Mr. McHenry's instructions issued when he was chief engineer of the Northern Pacific Railroad. In addition to the field book, there are monthly report sheets, 8½x14 inches, similar to typical form "E," which are used for compiling in office the field inspection notes.

G. H. Soles, Superintendent Bridges and Buildings, Pittsburgh & Lake Erie Railroad:

1. We have our bridges inspected every six weeks by a man out of the bridge gang on each division; he makes a written report of every defect he may find through his foreman to superintendent of bridges and buildings.

2. We do not have a regular bridge inspector for the current inspection of bridges.

3. We make annual inspection in October of each year. This inspection is made by general superintendent, chief engineer, assistant chief engineer, bridge engineer, assistant engineers, and superintendent of bridges and buildings. When inspection is completed a written report is sent to the chief engineer.

4. We use no special class of bridge inspection.

5. A general inspection.

6. By train and on foot.

7. Trackmen report any defects they may find on bridges to supervisors, which is referred to assistant engineers, then to superintendent of bridges and buildings.

8. Yes, sir, culverts should be inspected by the bridge department.

9. Any opening that is spanned by eye beams or wooden stringers is called a bridge regardless of its length, which I believe is correct.

10. Masonry and foundations of bridges should be inspected when bridge is inspected.

11. Our bridge and carpenter department is composed of gangs with headquarters at some convenient point on each division, and are taken off that division only in cases of emergency. We do not use blanks in making reports of bridge or culvert inspection.

A. D. Schindler, Superintendent, San Francisco and San Joaquin Valley Railway (Atchison System):

1. Inspection of all bridges, trestles, and culverts on this division of Santa Fé lines is made semi-annually in April and October by the bridge foreman, general foreman of bridges and buildings, and a representative of the chief engineer's office, and in the case of important structures or renewals requiring a considerable expenditure, by the superintendent.

2. We have no regular bridge inspector.

3. Inspection notes are compiled in book form, sample enclosed. After inspection has been made, a blank form (1900 standard), sample attached, is prepared in duplicate, one copy being retained in the office of the superintendent, the other forwarded to the general superintendent.

4. All large *wooden* truss bridges are attended by a watchman who makes a daily inspection.

5. In the case of trestles, particular attention is paid to the condition of stringers, caps, and piles; on wooden truss bridges the foundations and truss members, particularly the chords; for inspection and report on the condition of iron and steel bridges we depend almost entirely on the engineer department.

6. Piles are dug out by trackmen to a point below the line of decay in advance of the inspection. The inspecting party goes over the road on one or two gasoline motor cars. The tools most used are a ¾-inch octagonal bar, five feet in length, with chisel point at one end and flattened at the other. The chisel point is used for sounding the piles and the flattened end for probing deeper into the ground.

7. Trackmen dig out around the piles and refill the holes after the inspection as stated above.

8. In my judgment all culverts and trestles including timber cattle-guards should be under the inspection of the bridge department.

9. We have no well defined limit as to the length of structure which is designated as a bridge; in general, we consider all trussed structures as "bridges" in distinction from trestles.

10. Masonry and foundation of bridges should be under the inspection of the bridge department. In general, I do not consider it good practice to allow trackmen to do any work on timber structures as they have neither the tools nor the ability, and work which they attempt to do usually costs more than if handled by regular carpenters and is not done nearly so well. Our practice is to have the trackmen report the defects in structures and make only such emergency repairs as will keep the track safe for operation until the carpenters reach the ground. In case of a broken stringer or decayed pile bents they would crib up with ties under the structure until the proper repairs could be made.

11. Bridge department is under the direct charge of a general foreman of bridges and buildings who reports to the superintendent for instructions; all repairs are made with the approval of the superintendent; in important renewals, and particularly those of masonry foundation and steel structures, the approval of the chief engineer is also required; all new construction work in steel and masonry is handled by the chief engineer who also determines the amount of waterway required in *all* cases.

Note by Committee.—The field inspection report is similar to recommended form "C," issued in a book, 5½ x 8 inches, with instruction rules in front of book. The headings are: bridge number, kind (pile, trestle, or truss), length, height, date inspected. Condition of bridge and description of work to be done. Material required.

Form 990 is a large office sheet, in reality not an inspection report but a "work-sheet" on which complete data are given as to work to be done (based on the inspection returns), with estimated and actual costs of repairs, comparative forecasts of relative costs of repairing or replacing, more particularly with reference to filling in trestles.

O. D. Richards, Chief Engineer, Ann Arbor Railroad:

1. About twice a year by bridge foreman. Every time roadmaster is near bridge he looks it over. Section foremen every day.

2. No.

3. No report blanks.

5. Everything in sight.

6. Gasoline or hand car. Brace and bit, hammer, etc.

7. Daily.

8. Yes.

9. Twelve feet.

10. Should look at everything while there.

11. Carpenter and bridge gang combined.

A. B. Manning, Superintendent Bridges and Buildings, Missouri, Kansas & Texas Railway:

1. The inspection is made once every month.

2. I have regular bridge inspectors.

3. Annual inspection is made by the bridge inspectors and the general foremen. Reports are made to the superintendent of bridges and buildings, and they go from the superintendent to the chief engineer.

4. Every division foreman is also an inspector of his territory.

5. The principal points examined by the bridge inspectors on the trestle work is everything pertaining to the trestle. On iron work, everything pertaining to the span and masonry.

6. Bridge inspector has gasoline motor car and is assisted by one man. Carries with him hammer to test rivets, bar with bell end and sharp point to test timber and also a brace and bit.

7. We depend on the section men to report any accumulation of drift around bridges or trestles, also to report in case of fire that may cause trouble.

8. The section men inspect the culverts and report to the bridge inspector when he passes over the territory, and if there is anything serious the bridge inspector reports to superintendent of bridge and building department and he takes the matter up with the chief engineer later on.

9. Our limit on opening on road-bed to be classed as bridge is any place where daylight passes through deck.

10. Masonry and foundation of bridges is inspected by bridge inspector every time he goes over the road, which is once each month, and if he finds any cracks, or anything serious in the way of settlement, he reports to superintendent of bridge and building department and takes matter up with chief engineer and they examine the place together and determine what should be done.

11. Our bridge and building department consists of one superintendent of bridges and buildings, who reports to the chief engineer; two general foremen, who report to the superintendent of bridges and buildings; two iron gangs, who report to the superintendent of bridges and buildings; six mason gangs, who report to the superintendent of bridges and buildings; forty trestle gangs, who report to the general foremen, and also six house gangs, who report to the general foremen of bridges and buildings.

A. O. Cunningham, Bridge Engineer, Wabash Railroad:

I give the following information in reference to inspection of bridges and culverts on the Wabash Railroad:

1 and 2. A regular bridge inspector inspects bridges on his division every month. No report blanks are used.

3. An annual inspection of bridges is made by the chief engineer together with the bridge engineer and the division superintendent of bridges. No report blanks are used. Full stenographic notes are made regarding the condition of the structures.

4. There is no other special class of bridge inspection on our road.

5. The principal points of inspection in steel structures are the condition of the paint, the condition of the connections, the general strength of the span and the general condition of the masonry. With reference to wooden structures, the condition of the piling is ascertained and the condition of the timbers, especially where they come in contact.

6. A monthly inspection is made by the division inspector, who goes over his division of the road on a velocipede.

7. The track department makes no report of bridges or culverts.

8. Culverts should be inspected by the bridge department.

9. All openings in the road-bed are classed as bridges.

10. Masonry in foundations should be inspected thoroughly by the bridge department, because its cost is usually a great deal more than the superstructure, and is replaced with more difficulty.

11. The chief engineer has charge of all renewals and new work in the bridge department, having under him the bridge engineer with a bridge superintendent for each division. Each bridge superintendent has a bridge inspector with one or more bridge foremen and bridge gangs.

R. F. Henry, Supervisor Bridges and Buildings, Cleveland, Cincinnati, Chicago & St. Louis Railway (Big Four Route):

1. On the Chicago division of the Big Four R. R. we make a general inspection of all classes of structures at least four times a year. Inspection is made by a regular inspector, generally accompanied by the superintendent of bridges and buildings, and on one or more of these inspections by the engineer of maintenance of way and the superintendent of the division. We have no regular inspection blanks and the inspector makes no report on structures except those needing attention.

2. The inspector, or general utility man, is promoted from the ranks of bridge foremen and must be a practical man in bridge and building work. The first inspection is made early in the spring to ascertain general condition of bridges, trestles, culverts, depots, water stations, and track scales, for the purpose of laying out work in the way of repairs, and to ascertain what structures should have preference in the way of permanent work. On this inspection special attention is given to all abutments, piers, and small culverts, to ascertain what effect the high waters and winter freezing has had on them. Special attention is also given to concrete work, in the way of abutments, piers, and rail girders (we have some of these of 24 feet clear span, and as yet they are rather in the nature of an experiment and we are paying particular attention to them).

3. The second inspection is made during the summer when creeks are low and we have a better chance for examining the foundations of abutments, piers, and small culverts. The inspector is instructed to

make inspection on the following points on iron and steel spans: all rivets, chord bars, truss rods, brace rods, web of stringer, etc. Combination and Howe truss spans. All timbers are carefully inspected to determine condition as to soundness, etc. Deck and through girders are looked after for signs of rivets shearing, or plates buckling. Concrete girders, arches, and boxes are looked after for signs of injurious effects of frost, high water, etc.

4. This thorough inspection, however, is rarely made more than once a year, except in case of doubt; then they are looked after as often as is deemed necessary.

5. The inspector travels on a gasoline motor car, three-wheel when three or less persons go, and a double car when more than three persons are accompanying the inspector.

6. The tools usually used and carried by the inspector are as follows: Tile spade, auger, rivet tester, hammer, and timber pick for testing piling.

7. This department does not depend on the track department for any inspection, and I do not think that there would be any satisfaction in an arrangement of this kind, as reports from section men in regard to bridges or culverts are not, as a general thing, to be depended on, and if the bridge and building department is to be responsible for the safety of bridges and culverts they should undoubtedly be inspected by that department, and the same thing applies to abutments and piers of bridges.

8. On this division all steel, iron, combination, Howe truss, and plate girder spans are termed bridges, and all frame or piling trestles of more than one span are termed trestles; all frame and pile one-span openings, stone, and concrete boxes. Cast pipe and vitrified tile openings are termed culverts.

11. On this division the bridge and building department has charge of all bridges, culverts, cattle-guards, track and platform scales, coaling and water stations, passenger depots and freight buildings, and right of way fences, over a territory of 345 miles, including three large terminals, with organization as follows:

One inspector of bridges and buildings, one fence inspector, four bridge gangs, consisting of foreman, five carpenters, and five carpenter helpers, one house gang, consisting of one foreman, four carpenters, and two laborers, three concrete gangs, consisting of foreman, one carpenter, one finisher, and ten to fifteen laborers (we mix our concrete by hand), two fence gangs, consisting of foreman and five laborers, two pump repairers, one blacksmith and helper, one tinner and coppersmith, and three shop carpenters. Our painting is done by contract.

In addition to the force already mentioned we have a gang of roustabouts, consisting of foreman, two carpenters, and three laborers. These men are used in the yard except when needed on small rush jobs out on the road.

We pay the contractor for painting as follows: Bridges and buildings by the yard; switch stands, mile posts, etc., by the day, and all lettering at so much per letter.

W. M. Noon, Superintendent Bridges and Buildings, Duluth, South Shore & Atlantic Railway:

1. I inspect once in the spring as soon as the weather will permit a good inspection by myself and one or two men on motor car, usually

the water service foreman and a crew foreman of the division, and from that inspection I make up my needs for the coming year.

2. We do not keep a regular inspector.

3. The foremen of crews make frequent inspections on their respective divisions, which are usually about one hundred miles, and I go frequently where I think it is necessary. There is no regular form of report. It is done by the foreman by letter to the superintendent of bridges and buildings' office, and filed there if important.

4. I use no other method of inspection.

5. We make a thorough inspection of everything under the charge of the superintendent of bridges and buildings.

6. By gasoline motor car.

7. The section foreman is supposed to see the bridges on his section once or more every week, or as often as he can.

8. All openings on the surface or underneath the track and all buildings of every description are in charge of the superintendent of bridges and buildings.

9. Sixteen feet. All under that is a culvert, open or box, if of stone or wood.

10. The superintendent of bridges and buildings is held entirely responsible for all masonry foundations.

11. A brief outline of the organization of the bridges and buildings department is as follows: Foreman and crew of eight to twelve men, with a box car and flat car for tools, timber and lumber, hand and push cars, also sleeping and boarding cars, on about one hundred miles of line. The foreman is held responsible for the condition of all the bridges and buildings on his division, and is expected to keep as close watch of the same as the superintendent does. The foreman has a material book in which he keeps an account of all material received, on the left hand page, and charges out material used on the right hand page. This book is sent in to the superintendent's office at the end of each month, and is returned to the foreman after being checked up and posted. There is a daily report blank which he fills out with the number of men, names of men, and number of hours each man has worked, and a location and description of the work, also an account of all material received that day. The foreman keeps a monthly time book that is sent in at the end of each month, which has to check with the daily reports. We have an inspection book, of which I will send you a revised sample leaf. The right hand side gives a full description of the structure, and the left hand side is blank for notes.

Note by Committee.—The inspection report is issued in book form, 4¼ by 9½ inches, similar to typical form "E."

A. H. King, Foreman Bridges and Buildings, Oregon Short Line Railroad:

1. Inspection is made as near as practicable in September and October each year, once per annum, by the superintendent of bridges and buildings and division engineer.

2. No.

3. Partly covered by answer No. 1. These reports are made to the resident engineer in whose office they are ultimately filed.

4. Iron or wooden truss spans. I would recommend their inspection frequently by employees of engineering or bridges and buildings departments, and not less than twice per year.

5. In timber bridges, possible rotten piling, decayed or broken stringers or caps, loose bolts, possible spread of rails on curves, etc. In truss work, iron, see that adjustable members are equally strained, or take strain intended, see that expansion rollers are clean and work freely, that bolts or rivets are tight, and structure kept well covered with paint.

6. Usually by special train consisting of one car and a light engine not suitable for general traffic; superintendent of division and bridge foreman for that district usually accompany the party in places where stops are frequent; a hand car is employed, and bridge and building laborers used to assist in getting it over the road. Tools used are a $\frac{5}{8}$ inch steel bar and spade or shovel for inspecting piling, and a brace and $\frac{1}{2}$ inch bit for testing soundness of timber, and a small hammer for testing tightness of rivets.

7. Section men are instructed to examine bridges and culverts on their daily beat and are expected to note and repair irregularities which are apparent to anybody, such as bad surface, or line, fresh breaks in timber, washouts, or damage caused by high water, and track force are depended upon only to this extent, and to act in an emergency only until bridge men can get there.

8. Yes, and held responsible in my opinion for accidents resulting from lack of proper attention.

9. There is no specified length of span, all cattle-guards (pit) and bridges have ties under the rail; some small box culverts without ties called culverts. We have pit cattle-guards on piling that are nine feet long (standard) that answer for waterways; no bridge shorter than this.

10. Bridges and buildings department should understand it to be their duty to keep posted on condition of foundations and masonry and know that there is no hazard of an accident from defective condition of same.

11. Head of department has title of supervisor of bridges and buildings, and has the water system and pumping stations also under his charge, and all repairs or maintenance of all classes of structures except rolling stock of company to look after. New bridges or buildings may be built by either bridges and buildings or engineering departments. Foremen of gangs usually have boarding, sleeping, and tool cars assigned to their use, and may consist of from three to five (box) cars generally fitted up to handle the work to which they are assigned. Such tools as a carpenter usually has to work upon a building he is expected to furnish; company furnishes bridge augers, crosscut saws, steel bars, wrenches, and all heavy tools of this nature. We have painters, masons, bridge and house carpenter gangs, and special forces created, if occasion requires, on any line of work.

C. W. Vandergrift, Supervisor Bridges and Buildings, Chesapeake & Ohio Railway:

1. When I have a force of hands in the neighborhood of a bridge I require the foreman to go over it and examine all parts, rivets, etc. All of my foremen have these instructions, and they report direct to me. Have no regular blank form for this purpose.

2. We have a general inspector of bridges, Mr. J. M. Staten. He is supposed to inspect all bridges once a year, and reports to the general manager.

3. See answer to question 1.

4. See answer to question 1.

5. All points, pins, bearings, rivets, etc.

6. Four-wheel motor car is used.

7. Trackmen are supposed to look over all culverts after heavy rains.

8. I think not, but we do it.

9. Ten feet and up, clear.

10. Our masonry is generally of stone and any give always shows crack. This we have very little trouble with in mountainous country.

11. Our bridge department, or rather our carpenter department, so called, do all kinds of work from a cattle-guard to an iron bridge; put in all interlocking switches, etc. They report to the engineer of maintenance of way and myself, as a general rule.

H. H. Eggleston, Supervisor Bridges and Buildings, Chicago & South Eastern Railway:

1. Our current inspection of bridges will be made in June and December, twice a year, by myself and four men, on hand car.

2. We will not keep a regular bridge inspector, but will use a foreman to make a monthly inspection.

3. Our system for quarterly inspection is to go over bridges and all waterways and note the immediate repairs required; and our annual inspection is to make a general inspection on motor car and put in all information on our regular bridge sheets, which I send to the superintendent. This includes all renewals and changes for the next year. The superintendent notes same, and it then goes to the general manager for approval.

4. I think all roads should have a regular bridge inspector to go over road every month, make a thorough and careful inspection, and submit to the superintendent of bridges.

5. At every inspection we look into everything pertaining to bridges and waterways.

6. The inspection is made by myself and gang of four men, stopping at every bridge and waterway and thoroughly examining same. Use a motor car or hand car. Use bars to test piles and auger to bore timber, and hammer to test iron and rivets.

7. We do not depend on trackmen, only as they go over bridges, and should they notice anything wrong they notify superintendent at once.

8. Culverts should be inspected by the bridge department, as we put them in and maintain them.

9. We class all openings as bridges except pipe or stone arch.

10. We inspect all masonry and foundations of bridges, as we put them in and maintain them. They should be thoroughly inspected by noting any cracks or defects or settling whatever.

11. The bridge department is made up as follows: One paint gang of 4 men, and six bridge gangs (two gangs heavy work, 14 men each,

four gangs of 8 men each). Bridge gangs each equipped with a 36-foot tool car, fully supplied with the necessary bridge tools, hand cars, push cars, track dollys, etc.

W. M. Clark, Master Carpenter, Baltimore & Ohio Railroad:

1. System of current inspection on B. & O. R. R. is, that all bridges and culverts are examined personally, once every six months by the division engineer, once every three months by the master carpenter, and once every month by foreman carpenter or competent bridge man.

2. We do not keep regular bridge inspector.

3. All inspections are made by personal visits with hand car, we have no regular report blanks; we make a written report to division engineer of any defects discovered.

4. I have no special class of bridge inspection to recommend.

5. The principal points examined are all bearings, all stringers, and especially all foundations of wooden structures, all connections, and especially the riveting and deflections of iron structures.

6. Inspector goes over road on hand car. Tools used are those necessary to find loose rivets, augers to determine condition of wood, and also tools necessary to determine condition of foundations.

7. Track foreman to examine each bridge and culvert once each week, and to report his finding of defects to master carpenter.

8. All culverts should be examined by bridge department.

9. All openings over ten feet are classed as bridges; openings under ten feet are classed as culverts.

10. All masonry and bridge foundations should be inspected by the bridge department.

11. Master carpenter reporting to division engineer; foreman carpenter, mason, painter, water service, and signals reporting to master carpenter.

J. W. McCormack, Superintendent Bridges and Buildings, Chicago, St. Paul, Minneapolis & Omaha Railway:

1. Bridge inspection is made by the general bridge inspector for the system, myself and one man, usually the pile driver foreman.

2. Yes. Chief engineer furnishes inspector for the system.

3. Annual. No report made of inspection until estimate of work to be done is sent in, which goes to the division superintendent for all wooden bridges.

4. No.

5. Condition of timber, changes in waterways, and increase or decrease in volume of water and cause.

6. With gasoline car. Inspection ax.

7. Report any changes in surface and line.

8. Yes, sir.

9. Any opening in road-bed sixteen feet or more.

10. To see that they are in safe condition, and to report defects.

11. Chief engineer has all iron bridges to maintain, and the operating department the wooden bridges. A monthly report is made from my office to the engineering department of any renewals, repairs, and changes made on wooden bridges.

W. *E. Alexander, Superintendent Bridges and Buildings, Bangor & Aroostook Railroad:*

1. Inspections are made four to six times a year and reported in writing but without special blanks.

2. Superintendent of bridges and buildings makes all the inspections, and chief engineer at least one per year.

3. System of inspection is to make one early in spring, one in midsummer, and one late in fall. Other inspections are made between the above and through the winter, but not so critically. Reports are made to the chief engineer. No special blanks. These reports are filed in chief engineer's office.

4. Wooden bridges inspected by sounding and boring. Iron and steel bridges by measuring deflections under trains.

5. In the important periodical inspections all parts are examined as far as possible. In iron bridges testing for loose rivets by hammer, and in wooden bridges boring to detect rot. In pile bridges a sharp-pointed small bar is used to detect rot along the surface of ground. In less rigid inspections all parts are examined to see if any changes appear, and to see that adjustment of adjustable members is good.

6. A motor car or velocipede is used in going over the road for inspection. Rods, bar, ½-inch auger, and hammer.

7. Section foremen report by wire to chief engineer and roadmaster anything in connection with a bridge that needs attention, and do what they can to remedy any damage.

8. Culverts should be inspected by bridge inspector as well as by roadmaster.

9. Six feet is smallest opening under name of bridge. Arches of even greater width are not called bridges.

10. Masonry and foundations should be examined every summer by bridge inspector, who will select the time when water is lowest.

11. Organization. Two bridge crews under competent foremen lodged in boarding cars. These foremen to report to bridges and buildings superintendent, and he to chief engineer. The engineer of bridges is detailed to supervise important repairs or construction, and reports to the chief engineer.

E. E. Hart, Engineer, New York, Chicago & St. Louis Railroad:

1. All bridges and culverts are inspected once a month by regular inspectors. Attached is a specimen of report blank, with copy of actual report for December, 1902.

2. Regular bridge inspectors are kept on this line.

3. Semi-annual bridge inspections are made by the engineer, assistant engineer, and supervisor of bridges. An annual report is made

from this inspection in duplicate sent to the president and general superintendent. Copy is kept in each office.

4. The monthly and semi-annual inspections are all that are made on this road. There is no other special inspection that I would personally recommend.

5. In both semi-annual and monthly inspections all details of bridges are examined. All defects of whatever nature are watched for.

6. All monthly inspections are made by regular inspector going from bridge to bridge on velocipede car, carrying with him wrenches, etc., to replace any broken bolts or tighten loose bolts, adjust tension rods. Diagonal rods in iron and steel structures. Our semi-annual inspections have been made with gasoline motor car.

7. We depend upon track department to report promptly all defects that may occur at any time.

8. In my opinion culverts should be inspected by bridge department.

9. Fourteen feet minimum opening classed as a bridge.

10. The masonry and foundations of bridges are inspected by the bridge department.

11. Bridge department is organized on this road as follows: Engineer, supervisor of bridges, with inspectors and foremen.
We also have a bridge engineer who looks after designing and inspection of all new bridges built on this system. He gets up the complete plans.

Note by Committee.—The bridge inspection form is a single sheet, 14 x 8½ inches, similar to typical form "F," for reporting on trestles, with columns for reporting defective condition of any post, stringer, cap, etc., in any bent.

W. T. Powell, General Foreman, Colorado & Southern Railway:

1. We have a regular bridge inspector who gets over the territory allotted to him about every sixty days. We do not use a report blank.

2. Yes.

3. The superintendent of bridges and buildings makes an annual inspection of all structures. This inspection is for bridge and building department only.

4. No.

5. A thorough inspection of all bridges, culverts, cattle-guards, fences, and buildings.

6. Our inspector goes over the road on a velocipede car; uses a long chisel bar; superintendent of bridges and buildings usually goes over the road with division superintendent with special car, stopping at every structure.

7. None.

8. Yes.

9. Anything open at top.

10. Same as any other part of the bridge.

11. Each of our outfits have car—bunk car and material car. Foreman works by inspection notes furnished by general foreman; fore-

man reports every day to superintendent bridges and buildings what he is working at. We have foreman of water service, who looks after the pumpers and keeps pumps and boilers in repair. I enclose a blank that inspector fills out, showing work required on each bridge.

G. W. Stadly, Engineer Maintenance of Way, Algoma Central & Hudson Bay Railway:

1. Bridge inspection is made by the general foreman of the bridge and building department.

2. No.

3. Inspections are made quarterly. General foreman reports to engineer maintenance of way, who takes the necessary action and direction. Copies of reports are sent to general superintendent, and the originals are filed in the maintenance of way office.

4. Temporary trestles and bridges receive more frequent attention, and are personally inspected at least twice a year; we also make special inspection on the first of November, empty water barrels and store the same, pay special attention to guard rails, and see that everything is clear for passing of snow plow. In May the barrels are replaced, inspection made as to the effect of heaving, and, later, all vegetable matter, as dead brush, etc., removed from the vicinity of trestles in order to eliminate danger from forest fires.

5. Alignment, deflection, bolts, soundness of timber.

6. General foreman and two men go over division in hand car. They carry with them small tools, as sounding iron, lining bars, wrenches, etc., to make immediate small repairs.

7. Section foremen pay special attention during time of spring freshets and fall rains.

8. Yes.

9. All openings are classed as bridges in our record book, but only twelve-foot openings (standard span for trestle bridges) are numbered in the track.

10. Should be inspected for scouring, ice cutting, and pointing.

11. Engineer maintenance of way reports to general superintendent, stock clerk, general foreman, foreman, pile driver foreman.

I enclose herewith general rules governing our bridge department, also report blank and record sheets.

Note by Committee.—The inspection report blank is a single sheet, 8½ x 13¾ inches, similar to typical form "F."

A. S. Markley, Superintendent Bridges and Buildings, Chicago & Eastern Illinois Railroad:

It is our custom to make the annual inspection of bridges and buildings in the months of April and May, after the floods of the spring and winter and at the beginning of the season's work.

We begin at the south end of the line, to take advantage of the prevailing winds which at this season are generally from the south. The inspection party consists of myself, the foremen over their respective divisions, and four men, one of which is selected from each gang of bridge men, taking the most intelligent of them. The men go over the entire division while the foremen go over their respective divisions only. The advantage of selecting one man from each gang

is, that it does not cripple the bridge gangs from pursuing their usual work while the inspection is going on.

During the past three years we have used a double gasoline motor car, previously an ordinary hand-car. We find we can make much better time with the motor car, one reason being that when we reach a structure which is to be examined the men are fresh and ready for work having rested while the car ran from one structure to the next, while with the old method of pumping the hand-car (which with the inspection party usually ran very hard), when we came to inspect a structure the men were out of breath and unfit for the work. We have reduced the time necessary to inspect the entire line one day by the use of the motor car.

The railroad company pays the expenses of the inspecting party. The tools required for making the inspection are four three-quarter inch hexagon steel bars five feet long, diamond pointed at one end with a knob on the other; two shovels, two braces and bits, two mauls, and two pairs of hip rubber boots. We rely on the bars for most of the inspection. The brace and bit being used only in a few cases as mentioned hereafter, and the excavating tools only in loam or uncertain soil where timber is likely to decay far enough below the surface of the ground so that it cannot be properly tested with the bars.

When inspecting trestle work two of the men and the foreman go below, myself and two men above. The ends of stringers past four to six years old are probed with the diamond point bars in their ends where stringers as well as other material decay first as a rule. The ties are tested by the men above. My being above makes it easy to watch the inspection going on below and to communicate with the men when an unfavorable sound is heard from the bars being probed into rotten timber, or should they wish a decision on defects doubtful in their judgment.

Ordinarily in loose loam or sandy and dry soil, piles will decay first at the surface of the ground, to test such the bars are used. If wet or damp at all times, decay is likely to first appear almost anywhere between the cap and say three feet above the water. In many cases immediately under the cap, more especially if the cap is split or decayed so as to admit of water getting into the end of the pile. For testing piles under these conditions the brace and bit is used.

Above refers particularly to white and burr oak piles. The same is true of cypress piles if driven in wet ground and water; while if in dry banks decay will appear in most every place and at about one half the age found in the oaks referred to.

Concentrated load on corbels or stringers or caps render especially careful inspection necessary, defect in corbels being a little difficult to detect without boring into them. This should be done on the outside over the cap and in such a way that the water will not afterwards collect in the auger hole.

Piles some times settle unequally and cause caps to check and break.

Especial care should be used in keeping bents of all kind as near plumb as possible and where more than one deck, in line with each other. It often occurs where steel crawls and where ends of stringers are not properly anchored, the rails will carry the top of the structure with them. Bents in trestles not over twenty-two feet high have shifted sixteen inches out of plumb.

In the inspection of framed trestles and combination and Howe truss bridges, the points that are likely to show defects and decay first are points where the load is concentrated. In the former where posts rest on sills and intermediate caps, first indication of defects will be crushing under posts. This in almost every case will occur

under batter post first, though in rare cases under plumb posts. Posts will show decay at lower end. Very rarely will the defect in them appear in upper end unless cap is badly decayed to allow water to get into the end of them.

In Howe truss bridges defects first appear in bolsters and wall plates unless lower chord should be defective in packing, when same will show a joint opening or keys and clamp striping, the most important point being floor beams. In many cases they are too weak, showing defects first at knots checking or cross grained timber breaking, usually appearing under center first. Very rarely do compression members show defects first, though top chord not protected from weather has been known to become defective.

Special attention should be given to tension of rods on these bridges to see that they are uniform and properly adjusted. In inspecting, the usual method is to grasp a rod with both hands and give it a quick and sharp jerk; this will test the vibration and determine the comparative tension. All bolts throughout the structure should be tight at alltimes that no slack may exist between different members.

Wood culverts iron pipes, and similar openings are examined by two men, one going to each end and looking through; if any defects are visible or if culvert is very long so that it cannot be seen plainly, they crawl in and make an examination.

Iron bridges we examine almost entirely by observation, particular notice being taken of the condition of the rivets in the floor system, where the track stringers are riveted to the floor beams and floor beams riveted to the truss. If bridge is well painted there will be no difficulty in detecting loose rivets. I have made it a practice never to examine these rivets with a hammer except just previous to painting; to do so at other times spoils the paint and allows them to rust. I believe this practice is a safe one; I have pursued it for twenty years with good results.

The ties are inspected the same as on other bridges and the bearings on masonry are examined carefully to note any wear into bearing blocks or coping, expansion rollers or anchor bolts.

I examine all bridge and arch masonry myself. The foundation (the most important thing) I examine thoroughly. Ninety-nine per cent. of arch or masonry failures are due to foundations being undermined from time to time, eventually causing complete collapse during high water. This undermining is often due to insufficient waterway. In many cases ample waterway was provided at the time structure was built, but later the land above it is tilled out, and by this and other causes the water comes to the channel more rapidly, causing it to scour, and many times takes out arch paving or apron walls.

In all cases soundings should be taken along face of piers, abutments, and bench walls of arches. When the water is too deep to wade with rubber boots, sounding rods or poles should be used and bottom of stream checked with bottom of masonry, record of which should be on file in the office, and, in cases of probable danger, should be noted on left hand page of inspection book, in order that the exact condition can be determined on the ground at once and decision made as to what remedy to apply.

At such openings as cannot be examined properly by above method and to insure accuracy, soundings should be taken when the streams are frozen over; fifty feet each way from center of track and at intervals of twenty-five feet crossing and parallel with the stream, to note if any scouring has occurred, more particularly around piers and abutments.

The notes of the inspection are kept in 100-page, 4 inches by 6¼ inches, blank books, which have been previously prepared by the clerks in the office recording on the left hand pages the numbers, length, height, age, and general description of each opening and structure, arranged consecutively and spaced as past experience proves necessary.

On the right hand page opposite the inspection notes show the location and dimensions of timber that is to be removed, number and length of piles or posts needed, together with any other repairs or renewals found necessary. Memorandum is also made of highest stage of water since last inspection, and the water area at such times, which information is often found valuable in determining upon permanent structures, etc. The condition of station buildings, stock pens, and in fact every structure, is recorded in these inspection books. After the inspection is completed a report is typewritten covering the entire trip, one copy of which is sent to the chief engineer, and another is divided among the foremen, each getting a report of his division. This gives the foreman a set of general instructions on the work to be done on his division, and he is expected to do the work outlined in the report, except as specific instructions are given from time to time. They are expected to remedy any defect they find which was overlooked in the inspection, as well as complete all repairs noted on the report within reach of the particular piece of work they may have specific instructions to do. In many cases numerous smaller jobs can be cleaned up while waiting to be moved to and from more particular jobs, without any further instructions than the inspection report.

Mason R. Strong, Bridge Engineer, Erie Railroad:

1. Each division of the railroad has a local bridge inspector, usually the master carpenter, with an assistant inspector where necessary. Inspections are made semi-monthly by the division inspectors, who report to the division engineer. It is the duty of the division engineer to inspect bridges and masonry every three months, and his report is made to the engineer of maintenance of way, who reviews the report and forwards it through the general superintendent and the general manager to the chief engineer, who refers it to the bridge engineer. The bridge engineer has a general inspector of bridges, who inspects all bridges and masonry on all divisions and makes special report to him of the condition of structures and the manner in which the local inspection is being done.

2. Yes.

3. Semi-annual inspection trips are made by the chief engineer with the bridge engineer. Reports on bridge inspection are ultimately filed in the office of the bridge engineer.

4. None, except we look at the track on and near bridges as well as the structures themselves.

5. In pin bridges, all bars, pins, nuts, rivets, angles, connection of stringers to beams and beams to trusses, expansion joints, bed-plates, counter rods (especially in old bridges).

In drawbridges, also the end lifts, rollers, locks, gears, shafts, etc.

In all other types, in general as above; and in all bridges the action under passing loads.

6. Division inspector carries hammer, chisel, and spud to sound wooden structures. He travels on a track velocipede or hand-speeder car.

7. The trackmen are not called upon to inspect bridges.

8. Yes.

9. Every opening over which a rail will not carry is numbered and classed as a "bridge."

10. Masonry and foundations should be as rigidly inspected as any part of a structure.

11. The bridge engineer, reporting to the chief engineer, is assisted by an inspector of bridges, an assistant engineer, clerk, and draughtsmen. A shop inspector reports to the inspector of bridges. All bridges are erected by the railroad company. See No. 1.

Bridge Inspection Methods.

Data prepared by Messrs. I. O. Walker and Job Tuthill.

Atchison, Topeka & Santa Fé, monthly by general foreman, yearly by superintendent and general foreman.

Bangor & Aroostook, monthly and spring and fall regular by superintendent bridges and buildings.

Bismark, Washburn & Great Falls, monthly by bridge superintendent.

Boston & Maine, fall by inspectors and supervisors.

Burlington, Cedar Rapids & Northern, frequently by division foreman, annually by division engineer.

Chicago & Alton, quarterly by engineer maintenance of way, semi-annually by chief engineer.

Chicago & Eastern Illinois, frequently by foreman, annually by superintendent bridges and buildings and foreman.

Chicago & Northwestern, September and April by division engineer and superintendent bridges and buildings.

Chicago, Burlington & Quincy, by bridge superintendent.

Cincinnati, New Orleans & Texas Pacific, monthly by superintendent bridges and buildings, quarterly by chief engineer.

C., C., C. & St. Louis, frequently by supervisor, annually by engineer maintenance of way.

Duluth & Iron Range, monthly by foreman, spring and fall by superintendent bridges and foreman.

Florence & Cripple Creek, monthly by supervisor.

Fremont, Elkhorn & Missouri Valley, annually by division engineer and superintendent bridges and buildings.

Houston & Shreveport, semi-annually by superintendent and general superintendent.

Illinois Central, quarterly by bridge superintendent and foremen.

Intercolonial, annually by bridge inspector.

Jacksonville & St. Louis, monthly by bridge foreman.

Lake Erie & Detroit River, spring and fall by engineer and bridge foreman.

Lake Shore & Michigan Southern, spring and fall by general bridge foreman and principal assistant engineer.

Lehigh Valley, monthly by inspector, annually by bridge engineer.

Long Island, quarterly by bridge foreman, semi-annually by superintendent bridges and buildings, annually by engineer maintenance of way.

Louisville & Nashville, monthly by bridge foreman, quarterly by bridge superintendent, annually by bridge engineer.

Michigan Central, semi-annually by assistant bridge engineer and foreman, annually by bridge engineer.

Missouri, Kansas & Texas, frequently by inspectors and foremen.

Nashville, Chattanooga & St. Louis, frequently by bridge foreman and supervisor, annually by chief engineer.

N. Y. C. & H. R. R. R., continually by inspectors, quarterly by supervisor.

Norfolk Southern, monthly by supervisor, March and September by engineer maintenance of way.

Northern Pacific, January by superintendent bridges and buildings, September by division engineer and superintendent bridges and buildings.

Pecos Valley, semi-annually by general foreman bridges and buildings and inspector.

Penn. Lines West of Pittsburg, monthly by foreman, quarterly by master carpenter, annually by engineer of bridges.

Philadelphia & Reading, annually by bridge engineer and foreman.

Pittsburg & Lake Erie, frequently by foreman carpenter.

Santa Fé, Prescott & Phœnix, weekly by trackwalkers, semi-annually by chief engineer and general foreman.

Plant System, semi-annually by superintendent bridges.

Seaboard Air Line, spring and fall by bridge foreman and roadmaster.

Southern Indiana, semi-annually by engineer maintenance of way and superintendent bridges and buildings.

Southern Pacific, quarterly by inspector, foreman, resident engineer, and engineer maintenance of way.

Terre Haute & Indianapolis, spring and fall by master carpenter and engineer maintenance of way.

Toledo, Peoria & Western, annually by master bridges and buildings.

Union R. R. of Pittsburg, monthly by master carpenter, semi-annually by engineer maintenance of way.

W. Virginia Central & Pittsburg, spring and fall by bridge foreman and engineer maintenance of way.

Wheeling & Lake Erie, continually by inspector, annually by chief engineer and superintendent bridges and buildings.

Wisconsin Central, semi-annually by division engineer, principal assistant engineer, and general foreman.

DISCUSSION.

Mr. Reid.—I have not read the report in full, but along the line of close inspection I would like to ask how detailed an inspection is usually made on the annual inspection? On many of the roads I see that in some cases the chief engineer goes along, and in some cases the general superintendent and other high officials, whose time must be very limited, and I would like to ask how far the details are gone into, or whether they in a general way look over only the more important structures, iron or wood, or both?

Mr. A. S. Markley.—I have given that in my report. Will say that none of the higher officials go along. My report is sent to the chief engineer and, in addition to the inspection, I also take other notes and information that might be valuable at some future time.

Mr. Large.—On the system that I am connected with I make it a business to make the inspection myself, and I do it by myself as much as I can and take all the time necessary to do it. I make up report and furnish it to our engineer of maintenance of way and he fixes it up to suit himself and forwards it to our engineer of bridges and buildings, and in this report I say what ought to be done or what we should do after it has gone to them and they have looked it over, and then at an appointed time they come out with a special train and do not examine bridges that I have said nothing about, simply go to the bridges or buildings that I mention in my report, and then say what we shall do, and make provision accordingly.

Mr. Killam.—On the Intercolonial Railway we have thirteen divisions, 1,350 miles all told. I start at one end of the road and go from structure to structure, whether a pipe culvert, box culvert, or superstructure of any kind, and if the masonry needs pointing, if it is broken, or any bridge seats broken, I report that, and I go over the structures testing with hammers. I have an assistant with me, and test the rivets to see if there are any loose ones, and if any loose rivets are found I report them to the engineer of maintenance and he sends out men to put in new rivets, and so I go on from structure to structure

making a very minute and careful inspection and report everything, and the buildings the same way; examining the foundations, roofs, sheathing, etc., and report every room, and if it wants anything done to it, I give the size of the room, height of the ceiling, etc. It takes four months to go over the whole road. I then send in my report and the engineer of maintenance acts on it and gives instructions and the repairs are made. That is the way we do on our road. We do not miss anything and take no risks whatever for anything that wants to be done. I neglected to say that this inspection is made once a year, and in addition to this yearly inspection I have also taken the deflection of all of the spans.

Mr. Reid.—I have an inspector who makes a detailed inspection twice a year, and I make a personal inspection of the line once a year, as it is impossible to get over it oftener than that. He goes over the road and examines the rivets and pins and rollers and every detail about an iron or steel structure, also examines all pipe culverts, stone arch culverts, and makes a very detailed inspection and report of everything. He is a thorough, first-class bridge man, so that he knows what he is talking about. He examines everything. He notices the adjustment of the lateral braces and everything of that kind, and goes over the floor systems, and all, and then I go over later on and take him with me. He has the inspection report and we look over and examine any points necessary or advisable to look over and where everything is O. K. we do not stop at all. I have seen enough of his inspection to know that I can depend on his judgment, and I make the notes in my book and order the work done. Do not make any report. I order it done and direct the different ones to do the work, so that the report does not go beyond me at all. I would like to state that I also keep a bridge record book of every structure on the road, showing the length of span, whether deck, or through, kind of truss, etc., and in case of pipe culverts, diameter and length of the pipe, and the same information for stone, box, and arch culverts; and for trestle bridges, number of pile bents, frame bents, height, etc., and this becomes very convenient at times in case of an accident, fire, or washout, or something of that

kind, as when the number of the bridge is given we can tell just exactly what it will take to replace it, so that when a message comes in that such a bridge is gone, we know just what to do to replace it.

Mr. C. C. Witt.—I would like to say something about keeping a record of these bridges. In addition to the bridge book on our road, which has the length of spans, number of panels, height above water, etc., we have the inspector's personal book, and also have in the bridge engineer's office a file-card system, showing drawing numbers and general data. Every bridge on the road is marked on a separate card and these cards are kept in a case in rotation according to the bridge numbers, so that at a second's notice we can lay our hands on any drawing or data for any particular bridge.

Mr. Lichty.—On the North Western system we aim to have the bridge gang go over their bridges every sixty days, or as near that as possible, to tighten up loose bolts, examine blocking and piles, and their condition in general. The superintendent of bridges and buildings makes two inspections per year, in spring and fall, on the latter being accompanied by the division engineer. Besides this, the general bridge inspector, or his assistant, goes over the line once or twice a year examining more particularly the important structures.

Mr. Reid.—In regard to Mr. Lichty's remarks, there is no question but what that is advisable and desirable and makes a good plan of inspection where it can be carried out, but since I have taken general charge of the bridge work on our road it is possible for me to make but one inspection a year and it keeps me going to do that,—starting in five o'clock in the morning, working until dark, and working the inspection notes up in the evening until eleven o'clock at night. Having a special train makes it very desirable to return the engine to the roundhouse as early as possible to get rid of the train.

Mr. Trippe.—I would like to bring up for discussion the practice of members in inspecting covered Howe truss bridges and whether they uncover the bridge after a certain age, to get at all the timbers.

Mr. Reid.—In answer to Mr. Trippe's question I would state

that I have had doors made in the covering for this purpose. Ordinary truss bridges, if built of good timber and properly covered, the timber in them should last from twenty-five to thirty years without any decay. I have bored timber that had been in service in Howe truss bridges for twenty-five years and there was no rot or anything of that kind. It was in absolutely perfect condition. Sometimes the joints will open up a little but that cannot be helped. The truss might lose a good part of its camber but that is not particularly objectionable. Take a truss originally built with 2½ inches camber, it can afford to lose an inch or an inch and a half of its camber and still be in good condition.

Mr. Trippe.—I have found heart rot in several timbers of a bridge across the Platte river in Nebraska, that was built in 1886 or 1887. It was covered about two years after it was built, and the bridge is entirely white pine, I think Wisconsin pine.

Mr. Reid.—Good white pine, if it is properly protected, should not show heart rot in that length of time.

Mr. Alexander.—Our chief engineer goes over our road at least once a year for a general inspection, and I do all the other inspecting of bridges, and report anything that I find necessary or that his attention should be called to, and anything needing immediate attention I order repaired and report to him also what action taken; but if it is something that can wait for his annual visit to the bridge I go with him and show him everything that I wish him to see so as not to detain him on his trip any longer than necessary. Referring to Howe truss bridges, if a bridge can be thoroughly covered so that no water gets to it, we find there is no great trouble so far as rot is concerned. I know of such a bridge that was built nearly sixty years ago near Bangor, Me., an inspection of which sometime ago showed that it was still in good condition.

Mr. Sheldon.—It has been our experience that if the timber in a Howe truss is in good condition when put in and protected from the weather, there will be little or no deterioration in the timber of that bridge. I have quite a few now that are fifty years old or more, and the wood is still in good condition.

Mr. Carpenter.—I do not know that I have very much to say. I have a paper on this subject embodied in this report that shows about where I stand, but I would like to say that I think we can inspect the rivets too rigidly and too often, and we can also bore the timber too often for the purpose of inspection. I do not think we ought to bore it to pieces to keep it from getting rotten. I think a man ought to know what the condition of his timber is by keeping a record of all previous borings made in it, so as to let it run as long as possible before boring it again, otherwise good timber is liable to be spoiled by too frequent boring. I would also like to say that in case of girder bridges I think they should be so designed so that we could get inside and around them to examine them without bringing along a work train with a lot of scaffolding for it. This is an important point, and I think the engineers who design these girders and foundation or abutments for them ought to take this matter into consideration. It would save the companies for which we are working considerable money.

Mr. Stearn.—Mr. President, I would like to raise the question as to the proper time for covering wooden bridges after their erection.

Mr. Lichty.—In regard to the proper time to cover Howe truss bridges, it is not so much a question as to whether a bridge should remain uncovered any length of time, as it is to take a Howe truss or any timber in a truss and paint it before it is well seasoned.

Mr. Killam.—In reference to the inspecting of bridges and getting under them to inspect them, I would say that I had a little iron ladder made for this purpose, which I have been using to good advantage for some time.

Mr. McIntyre.—I do not think the covering should be put on Howe truss bridges until all the timbers are thoroughly seasoned, and chord and lateral bolts tightened.

Mr. Sheldon.—In reply to Mr. Stearn's inquiry as to how long timbers should stand before being covered, I have had some experience along this line and am of the opinion that if your timber is thoroughly seasoned it can be covered immedi-

stely after being erected. If not thoroughly seasoned it should be left for a year or more so the air can have free access to it, to be thoroughly seasoned before being covered. And I would also say that our experience has been if your timber is thoroughly seasoned before it is painted it does little damage except that it is a hindrance to inspection. If your timber is not thoroughly seasoned then the painting is positively injurious in every way.

Mr. Burpee.—I think the timber ought to be covered immediately if covered at all, but it is well to let the sides remain open for a reasonable length of time so as to allow the air to circulate through to season the timber.

Mr. Reid.—Our practice on the Lake Shore when building Howe trusses was usually to build them one season and cover them the next. In regard to painting the timbers we do not paint Howe trusses at all. We never did. I think in a good many cases good whitewash is better than paint.

Mr. A. S. Markley.—In regard to painting the Howe truss bridges I think if the timbers are not well covered, but are exposed to the weather, that it is simply time and money thrown away, putting it on. One thing, Mr. President, that occurred at the Kansas City convention, a number of years ago, and which I have always remembered, was a remark by Mr. F. H. McGuigan, at that time superintendent of the Wabash Railroad, now general manager of the Grand Trunk, to the effect that it was wonderful how cheap the members could do a certain kind of work in the convention hall, but when it comes to doing it out on the road it was quite different, and so I think perhaps the same thing applies to inspection. We make a more rigid inspection here than we do out on the road.

President.—I think the point is well made, but if we did not make this inspection here we would not do it on the road as well, and we will every one of us go back home to do better service because of our having talked these matters over here in this convention.

IX.—Water Filters, or Other Methods of Purifying Water for Engine Use.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Gentlemen.—With a desire to learn as much as possible on the subject "Water filters or other methods of purifying water for locomotive use," I attended a meeting of the Western Railway club February 17, 1903, at which meeting this subject was fully discussed, and I will use as part of my report a paper read at this meeting entitled, "The C. & N. W. Ry. Co's Method of Purifying Water for Locomotive Boilers," by Mr. G. M. Davidson, chemist and engineer of tests. Following this paper and discussion will be found a statement showing cost of purifying water on the C. & N. W. Ry.

Next a list of railroads in the United States and Canada whose mileage is 1,000 miles or more, to whom I mailed the following circular letter:

Chicago, Sept. 1, 1903.

Dear Sir:—As chairman of committee on "Water filters or other methods of purifying water for engine use" for the Association of Railway Superintendents of Bridges and Buildings, I am after information to compile a report for the annual convention, to be held at Quebec, October 21 and 22, 1903.

If consistent for you to answer any of the following questions, I would be greatly obliged for the information:

1. Have you water purifying plants in operation on your road?

If so, what system?

2. What is the estimated cost per thousand gallons for purifying water?

3. Do you consider the saving in the expense of repairing boilers warrants the cost of purifying the water before it is put in the boilers?

4. Have you had water purifying plants in operation long enough so you can give amount saved in cost of repairs per locomotive per year by using purified water? If so, please state the amount.

5. Can you send me a statement showing the operation of any of your plants?

A reply with answer to all or any of the above questions will be greatly appreciated and *I will reciprocate* by sending you a copy or report made by our committee at the convention.

On account of the short time that I have in which to make

up my report I would be pleased to have you reply not later than September 19.

Hoping that I may receive the information from you as requested, I am,

Very truly yours,
R. C. SATTLEY,
Supt. B. & B.

Answers were received from twenty-five railroads out of thirty-five to whom the above circular letter was sent. The answers to my letters from the various railroads are printed as received, except those who stated that they had no plants of this kind on their road.

THE CHICAGO & NORTH WESTERN RAILWAY COMPANY'S METHOD OF PURIFYING WATER FOR LOCOMOTIVE BOILERS.

By G. M. Davidson, Chemist and Engineer of Tests C. & N. W. Ry. Co.

INTRODUCTION.

In the preparation of this paper I have in mind the fact that comparatively few of the members of the Western Railway club are chemists, and, therefore, I will endeavor to present the subject in a popular rather than a scientific manner. I will avoid technical language as much as possible. The purification of water for boiler use is so simple that a knowledge of chemistry is not necessary to understand the principles involved.

WATER IN GENERAL.

Water occurs abundantly diffused in nature. It is the largest component of plants and animals. Five eights of the human body is water. It has been estimated that 99 per cent. of the water on the earth is in the oceans. From these oceans, as well as from lakes, rivers, swamps, and other moist places, evaporation is constantly going on. The water thus evaporated rises as vapor and is carried away. When the clouds that carry this vapor come in contact with a cool current of air, the moisture in them is condensed and falls in the shape of rain, snow, or hail. The air is constantly charged with more or less water. We have evidence of this on warm days by the drops of water that are seen on the outside of a pitcher containing ice water. We also often see the water that is condensed on the outside of a locomotive tank when the water inside the tank is cooler than the temperature of the outside air. This phenomena is also exhibited in the shape of fog, dew, and hoar frost. The atmosphere is never absolutely dry. When it contains 85 per cent. to 95 per cent. of water we call it damp; when it has 65

per cent. we call it dry; 50 per cent. very dry; and 35 per cent. extremely dry.

Three forms of water are familiar to us. These are—

1. The solid form—as ice.
2. The liquid form—as water.
3. The gaseous form—as steam.

Chemically speaking, water is a combination of two gases—hydrogen and oxygen—combined in the proportion of two parts of hydrogen to one part of oxygen. Hydrogen is the lightest known gas. Oxygen is one of the components of the air. If a mixture of these two gases is brought together in the proper proportions and a flame or electric spark is applied, they will unite and form water.

As stated previously, water is precipitated from the clouds in the shape of rain, hail, and snow. When it strikes the earth a portion of it runs away on the surface and forms small rivulets and streams, which unite to form rivers and lakes. These in turn empty into the oceans. A portion of water which falls on the earth, instead of running off on the surface, is absorbed by the soil, and after passing through the strata, reappears in the form of springs, or is found beneath the surface by boring or digging wells.

WATER USED IN BOILERS.

Rain water is, for all practical purposes, a pure and soft water. The only impurities that it contains are the dust which it takes up in falling through the air, and the carbonic acid gas which it absorbs from the air. Rain water is a great solvent. Under ordinary atmospheric pressure it dissolves its own bulk of carbonic acid gas. When in passing through the soil and through various rocks, it comes in contact with minerals that are soluble in water, it dissolves them and carries them along in solution. If the rain water falls in a region where the predominating rock is granite, slate, or some such nearly insoluble substance, it does not dissolve much of it. If, however, it passes through a region where the predominating rock is limestone or that contains compounds of lime or magnesia, the rain water dissolves these and causes the water to be what is called "hard water." In many regions the dissolving effects of water upon limestone is continually going on, resulting in the formation of caves such as Mammoth cave in Kentucky.

The character of water for boiler use may be influenced by the following:

1. By the kind of rock and soil through which it passes.
2. By the depth to which it penetrates the rock and soil.
3. By the time that it remains in the earth.

All natural water contains more or less solid matter in solution, or mixed with it mechanically and held in suspension.

The ideal water for use in locomotive boilers is one that does

not deposit scale, does not corrode, and does not cause the boilers to foam. Unfortunately such a water does not exist in nature. A railroad running through a certain section of the country is obliged to use in its locomotive boilers the water found in that section. With a railroad located like the Chicago & North Western, the variety of water used for boiler purposes is very large.

In the northern part of Wisconsin and Michigan along the Ashland and Peninsula divisions, the country is dotted with small lakes and swamps which act as reservoirs for the storage of water derived from melted snow and rain. This water does not get a chance to percolate through the soil, but runs quickly into the swamps, lakes, and streams. There is no trouble with locomotive boilers accumulating scale when running through that region. Practically only natural soft water is used. The following analyses indicate the character of this water:

Name of Station.....	Grand Rapids, Wis.	Cedar, Wis.	Wellington, Mich.	Little Lake, Mich.
Source of Supply.....	Well near bank of Wisconsin River.	Spring.	Branch of Presque Isle River.	Well 500 feet from Lake.
Total solid matter dissolved in 1 gallon.....	5.24	1.89	5.49	4.96
This solid matter consists of the following:				
Carbonate of lime.....	1.15	0.39	1.51	0.06
Carbonate of magnesia.	1.14	trace	0.55	trace
Sulphate of lime.....	0.78	.....	0.23	1.90
Sulphate of magnesia...	.....	.....	.....	0.79
Iron and alumnia oxides	0.03	0.08	0.09	0.29
Silica.....	0.93	0.60	0.50	0.51
Incrusting solids.....	4.03	1.07	2.88	3.35
Alkali chlorides.....	0.04	0.25	0.48	1.30
Alkali sulphates.....	0.56	.....	.....	0.11
Organic matter.....	0.61	0.57	2.13	0.20
Non-incrusting solids	1.21	0.82	2.61	1.61
Pounds of scale-forming matter in 1,000 gallons	0.57	0.15	0.41	0.48

Note.—The figures express the number of grains (Troy weight) in one U. S. Standard gallon (231 cubic inches).

Along the shore of Lake Michigan and southern Wisconsin, where water can be conveniently pumped from the lakes and rivers, the water is comparatively soft and is considered good for boiler purposes. The following analyses show the character of this water:

Name of Station.....	Chicago.	Cary, Ill.	Oshkosh, Wis.	Red Granite Junc., Wis.
Source of Supply.....	Lake Michigan.	Fox River.	Lake Winnebago.	Creek.
Total solid matter dissolved in 1 gallon.....	7.78	14.23	11.24	10.85
This solid matter consists of the following:				
Carbonate of lime.....	4.46	6.02	4.67	5.11
Carbonate of magnesia...	2.20	5.64	3.32	3.80
Sulphate of lime.....	0.30	0.07	0.43	.....
Sulphate of magnesia.....	.....	.....	0.77	.....
Iron and alumina oxides.	0.02	0.12	0.09	trace
Silica	0.30	0.48	0.23	0.67
Incrusting solids.....	7.28	12.33	9.51	9.58
Alkali chlorides.....	0.22	0.57	0.62	0.27
Alkali sulphates.....	0.28	1.33	1.11	1.00
Non-incrusting solids	0.50	1.90	1.73	1.27
Pounds of scale-forming matter in 1,000 gallons..	1.04	1.76	1.36	1.37

Note.—The figures express the number of grains (Troy weight) in one U. S Standard gallon (231 cubic inches).

On the Iowa division some of the waters contain considerable scale-forming material. They are hard waters and on account of the fast time of the passenger trains, heavy tonage of freight trains, and large number of locomotives in service on this division, are the cause of much expense to the company, as well as much annoyance and trouble to the motive power department. The following analyses show the character of these waters:

Name of Station.....	Council Bluffs, Iowa.	Dunlap, Iowa.	Denison, Iowa.	Boone, Iowa.
Source of Supply.....	Well 70 feet deep.	Well 28 feet deep.	Well 25 feet deep.	Well 104 feet deep.
Total solid matter dissolved in 1 gallon.....	53.67	40.42	24.19	23.04
This solid matter consists of the following:				
Carbonate of lime.....	24.39	16.11	14.68	13.46
Carbonate of magnesia...	1.18	2.25	2.51	7.06
Sulphate of lime.....	6.22	5.41	3.60	.....
Sulphate of magnesia.....	13.33	9.92	1.20	.....
Iron and alumina oxides	0.34	0.16	0.09	trace
Silica.....	1.42	1.52	0.96	1.74
Incrusting solids.....	46.88	35.37	23.04	22.26
Alkali chlorides.....	1.21	2.06	1.15	0.09
Alkali sulphates.....	5.58	2.99	.....	trace
Alkali carbonates.....	.....	.....	.....	0.69
Non-incrusting solids	6.79	5.05	1.15	0.78
Pounds of scale-forming matter in 1,000 gallons..	6.69	5.05	3.29	3.18

Note.—The figures express the number of grains (Troy weight) in one U. S. Standard gallon (231 cubic inches).

The following diagram which I have prepared shows at a glance the general character of the water supply of the main line of the C. & N. W. Ry. Co., from Clinton to Council Bluffs, Iowa.

On the Minnesota and Dakota division the waters are much worse than elsewhere on this railroad. Not only do they contain in solution much lime and other scale-forming matter, but many of them also contain a very large quantity of alkali. The following analyses show the character of these waters :

Name of Station.....	Tyler, Minn.	Walnut Grove, Minn	Redfield, S. Dakota.	Salem, S. Dakota.
Source of Supply.....	Well 575 feet deep.	Well 40 feet deep.	Well 18 feet deep.	Well 16 feet deep.
Total solid matter dissolved in 1 gallon.....	140.36	201.16	238.50	152.88
This solid matter consists of the following:				
Carbonate of lime.....	35.08	42.75	46.68	13.78
Carbonate of magnesia...	8.20	19.01	2.75	4.93
Sulphate of lime.....	15.04	42.59	8.70	84.45
Sulphate of magnesia. ...	24.75	32.10	56.35	37.70
Iron and alumina oxides	0.30	trace	1.39	0.08
Silica.....	2.00	1.45	2.11	1.57
Incrusting solids.....	85.37	137.90	117.98	142.46
Alkali chlorides.....	1.46	1.21	13.50	9.77
Alkali sulphates.....	53.53	62.05	102.02	0.65
Non-incrusting solids	54.99	63.26	115.52	10.42
Pounds of scale-forming matter in 1,000 gallons...	12.19	19.70	16.85	20.35

Note.—The figures express the number of grains (Troy weight) in one U. S. Standard gallon (231 cubic inches).

PRACTICAL RESULTS FROM THE USE OF SOFT AND HARD WATER IN CHICAGO & NORTH WESTERN RAILWAY CO.'S LOCOMOTIVE BOILERS.

The principal business of that portion of "The North Western Lines," located in northern Wisconsin and northern Michigan, is transporting iron ore from the mines to the lake ports of Escanaba and Ashland. This business is practically a summer business, for as soon as winter sets in and navigation on the lakes closes, the heavy business ceases until spring, when navigation reopens. As soon as the transportation of ore is stopped in the fall, the large locomotives engaged in that traffic are transferred to other divisions and are used for hauling the fall crops to market. While these locomotives are engaged in the ore traffic in the region where the water is good they give little or no trouble from leaky flues, cracked plates, or other troubles

attributed to bad water. As soon, however, as they are transferred from the good water district into the poor water district where the water is known to contain much lime, magnesia, and such scale-forming matter, they commence to give trouble.

I present the above facts because they have for a number of years proved conclusively to the officers of the Chicago & North Western Railway Company that poor water is responsible for a great deal of trouble with boilers not steaming as they should, burning extra large quantities of coal, as well as being the chief cause of leaky flues, cracked plates, and other troubles well known to railway men.

BOILER COMPOUNDS.

The number of boiler compounds on the market are so numerous that I will only refer to a few of them in a general way. Some are entirely mechanical in their action, such as wires, plates, twigs, and brushes, which are supposed to catch and entangle the scale-forming matter and prevent it depositing and forming hard scale. Others are supposed to have a chemical action, and indeed are well known chemicals that do have such action, but the high prices of such chemicals limit their use. Others, like potatoes, peas, wheat, moss, crude oil, kerosene, etc., are of some little benefit because they form centers about which the lime and magnesia gather and thus prevent the formation of hard scale.

It was once customary for owners of boilers to use various boiler compounds, boiler purgers, boiler scale dissolvers, and similar nostrums, which were offered from time to time and which were represented to cure the evils due to the use of poor water. After experimenting and trying a great many of these boiler compounds it was concluded that while many of them seemed to give fairly good results, yet a large portion were humbugs. Many of them contained well known chemicals which, when properly used, would give fair results. Some of them contained material that yielded doubtful results. Some of them were found to contain chemicals which were known to be very harmful to boilers. A few of them, which were manufactured in the vicinity of Chicago, were found to consist largely of Lake Michigan water, which was disguised by mixing it with certain material to change its appearance. Nearly all of the boiler compounds that gave fairly good results were found to contain soda ash. Generally this was colored or disguised in such a manner that a chemical analysis was necessary to detect it.

Some ten years ago it was found that if properly used, soda ash in locomotive boilers would yield fairly good results. You will note that I say "if properly used," because it was found that if used improperly, soda ash would do more harm than

good to a locomotive boiler. When soda ash was first used, the locomotive engineers were divided into two classes in regard to their opinions as to the benefit derived from its use. Some of them declared it did good work in locomotive boilers, while others declared just the reverse. Upon investigation it was found that the proper use of the blow-off cock had much to do with the results obtained. If the engineer used the blow-off cock frequently and thus removed the "sludge" and concentrated water from his boiler the results were generally fairly satisfactory.

A boiler, however, was not designed for the purpose of treating water with chemicals and the use of a locomotive boiler as a vessel in which to carry on a chemical operation was found to be poor practice. As the use of boiler compounds required their introduction into the boiler, they did not meet with very much favor.

SOFTENING OF WATER BEFORE IT IS USED IN BOILERS.

The hardness of boiler water depends upon the quantity of lime and magnesia compounds that it has in solution. There are two kinds of hardness, commonly distinguished as "temporary hardness" and "permanent hardness."

"Temporary hardness" is due to carbonate of lime and carbonate of magnesia held in solution by carbonic acid gas. Such water may be softened by boiling and thus driving off the carbonic acid gas, or by adding to the water some chemical that will unite with or absorb the carbonic acid gas.

"Permanent hardness" is due to the sulphates of lime and magnesia, and sometimes some other compounds which are dissolved in the water. These remain in solution after water is boiled because they do not depend on carbonic acid gas to hold them in solution.

The principles of the art of water softening have been known for over 100 years, but it was not until the year 1841 when Dr. Clark, of Scotland, took out his famous patent for softening water on a large scale, that an attempt was made to soften water for boiler use. The Clark process is the basis for all other water softening processes that have been commercially successful.

The chemical treatment of water before it is used in boilers has been carried on in Europe for a number of years, but only recently has the subject been given much thought in this country, even for stationary boilers, and the purification of water for locomotive boilers has only been taken up by the railway companies during the past few months.

CHEMISTRY OF WATER SOFTENING.

All water used for boiler purposes, unless it is rain water collected from the roof of a building and not allowed to come in

contact with the earth, contains more or less scale-forming material in solution. This scale-forming material is composed of compounds of lime, magnesia, iron, alumina, silica, etc. Of these the carbonate and sulphate of lime and the carbonate and sulphate of magnesia form 98 per cent. of the scale and it is these four compounds that generally cause trouble in boilers. It is to the removal of these compounds that I will particularly call your attention.

CARBONATE OF LIME is the chemical name for common limestone, marble, and chalk. It is the commonest form in which lime is found in water. It is but slightly soluble in chemically pure water, but is readily soluble in water which contains carbonic acid gas. Rain water, in falling to the earth, absorbs carbonic acid gas from the atmosphere. When water charged with carbonic acid gas passes through the soil it dissolves more or less of the lime that is in the soil. In localities where such water comes in contact with limestone, the amount of lime dissolved by water passing through it is very large. When such water is boiled the carbonic acid gas is driven off by the heat, and the lime which was held in solution by it is deposited on the inside of the boiler. Carbonate of lime alone does not form very hard scale, but it is rather bulky because when crystallizing carbonate of lime combines with many times its weight of water. The white chalky matter that is washed out from boilers and which can often be seen about roundhouses, is impure carbonate of lime. Since carbonate of lime is held in solution in water by the presence of carbonic acid gas, any means that will remove the carbonic acid gas from the water will at the same time throw out of solution the carbonate of lime. There are many chemicals which when added to cold water will combine with the carbonic acid gas in the water and thus remove it from the water. The one chemical most available for this purpose because of its great abundance and low cost, is common building lime. This is called quick lime. Chemically considered, it is a compound of lime and oxygen. When common lime is mixed with water it unites with a portion of the water and forms a new product, commonly known as slaked lime, which is chemically called hydrate of lime. When slaked lime is added to water containing carbonate of lime held in solution by carbonic acid gas, it unites with this carbonic acid gas, forming carbonate of lime, which being insoluble in the water freed from its carbonic acid gas, settles down as a white precipitate. The carbonate of lime, which was held in solution by the carbonic acid gas, is thrown out of solution as soon as the gas is removed by the slaked lime, and also settles in the form of a white precipitate. Therefore, to remove carbonate of lime from a water before it enters a boiler, it is only necessary to add to the water the proper amount of slaked lime required to combine with the carbonic acid gas that holds the carbonate of lime in solution, and allow the resulting precipitate to settle.

The clear water above the sediment that settles out, can then be used in a boiler without causing scale to be formed from any carbonate of lime that may have been in the water before it was treated.

SULPHATE OF LIME, which is commonly known as gypsum or plaster of paris, is found in a great many waters and is responsible for the hard scale which is often found on flues and crown sheets of boilers. Scale formed from sulphate of lime alone is often as hard as porcelain. It is not thrown out of solution until the water is heated considerably above the boiling point, namely, 302 degrees Fah., which corresponds to about 55 pounds boiler pressure. The sulphate of lime is precipitated in the form of heavy crystals, which unite with such other deposits as are in the boiler, and form a hard cement-like coating on the flues and sheets. It is a very poor conductor of heat, so that when flues are coated with it it is necessary to burn a greater amount of coal in order to produce steam. Sulphate of lime being soluble in water that is free from carbonic acid gas, it cannot be removed from water by means of slaked lime. It can, however, be removed by means of carbonate of soda, commonly known as soda ash. The chemistry of this process is as follows:

When a water containing sulphate of lime dissolved in it is mixed with a water solution of carbonate of soda, a chemical reaction takes place. This chemical reaction may be expressed as follows: *Sulphate of lime and carbonate of soda when dissolved in water and mixed, react and form carbonate of lime and sulphate of soda.*

The sulphuric acid which was combined with the lime as sulphate, leaves the lime and combines with the soda, forming sulphate of soda, while the carbonic acid gas, which was combined with the soda, leaves the soda and combines with the lime, forming carbonate of lime. Carbonate of lime, being insoluble in water free from carbonic acid gas, settles down as a white precipitate, while sulphate of soda, being soluble, remains in solution. Therefore, to remove sulphate of lime from water before it enters a boiler, it is only necessary to add to the water the proper amount of soda ash required to combine with the sulphate of lime, allow the resulting white precipitate to settle, and then draw off the clear water.

CARBONATE OF MAGNESIA is the commonest form of magnesia. It acts like carbonate of lime, being held in solution by carbonic acid gas dissolved in the water, and thrown out of solution when this gas is driven out of the water. By simply mixing slaked lime with water containing carbonate of magnesia in solution, the carbonate of magnesia is thrown out of solution in a manner somewhat similar to carbonate of lime, already described, so that the treated water when used in a boiler does not deposit scale from any carbonate of magnesia that was in the untreated water. We are all familiar with the magnesia

boiler lagging which is applied to the outside of the boiler to prevent the radiation of the heat, on account of magnesia being a poor conductor of heat. When the magnesia, however, is deposited on the flues or firebox inside of the boiler, it is surely on the wrong side of the shell.

SULPHATE OF MAGNESIA, commonly known as epsom salts, does not of itself form boiler scale, but when it is in a boiler with a soft carbonate of lime scale, a chemical reaction takes place which results in the formation of hydrate of magnesia and sulphate of lime. These two compounds form a very dense scale as hard as stoneware. Sulphate of magnesia can be removed from water before it enters a boiler by treatment with caustic soda, or what amounts to the same thing, and is cheaper, with slaked lime and soda ash.

The above mentioned two compounds of lime and two compounds of magnesia are the cause of almost all of the trouble with boiler waters that deposit scale, and are also the cause of much extra coal being used to generate steam. Rankine, in his book on mechanics, states that the resistance to the passage of heat offered by wrought iron being taken as 1, that of copper is 0.4; of slate 9.5; of brick 16.; carbonate of lime 17.; and of sulphate of lime 48.

Sometimes a water that is obtained near mineral veins contains free sulphuric acid, and, of course, such water is very corrosive. The addition of lime to such water neutralizes the acid. Water from mountain streams and from streams near waterfalls is also corrosive. This is due to the absorption by the water of oxygen and carbonic acid from the air. Likewise water that has had air pumped into it is corrosive for the same reason. Some waters from streams contain sand or mud in suspension. These can be removed by filtering, or precipitated by the use of alum or sulphate of alumina. If such water is hard it can be softened at the same time that suspended matter is removed.

Briefly stated, the scale in locomotive boilers is due to one or more of the following causes:

1st. Deposition of lime and magnesia carbonates, due to the boiling off of the carbonic acid gas from the water in which they were dissolved.

2d. Deposition of sulphate of lime, due to high temperature in the boiler.

3d. Deposition of magnesia compounds, due to their decomposition in the boiler.

4th. Deposition of sand, clay, and other matter that was suspended in the water.

5th. Deposition of alkali salts, due to concentration.

The following table presents in condensed form some well known facts in regard to troubles with boiler waters:

Cause of Trouble.	Nature of Trouble.	Remedy.
Carbonate of lime	Soft scale	Treatment with slaked lime.
Carbonate of magnesia	Soft scale	Treatment with slaked lime.
Sulphate of lime	Hard scale	Treatment with soda ash.
Sulphate of magnesia	Hard scale	Treatment with slaked lime and soda ash.
Carbonate of iron	Soft scale	Treatment with slaked lime.
Chloride of magnesia	Corrosion	Treatment with soda ash.
Sediment, sand, clay, mud, etc	Scale	Treatment with alum. Filter. Allow to settle.
Dissolved oxygen and carbonic acid gas	Corrosion	Treatment with slaked lime.
Organic matter	Foaming and corrosion	Treatment with chemicals.
Alkali	Foaming	Frequent blowing off.
Acid	Corrosion	Treatment with slaked lime.

It will be noted that slaked lime and soda ash in the above table are frequently prescribed as remedies. There are many other chemicals that can be used to accomplish the same purpose, but they are much more expensive and generally no more effective than the two designated.

MECHANICAL OPERATIONS.

We have seen by the foregoing that in order to remove from hard water the scale-forming compounds of lime and magnesia, it is only necessary to mix with the hard water the proper amount of slaked lime and soda ash. The mechanical operations required may be classified as follows:

1st. Weighing, mixing, and dissolving the lime and soda ash in water so that the resulting mixture will have a uniform and constant strength.

2d. Mixing a certain predetermined quantity of this chemical solution with a certain predetermined quantity of the hard water, and agitating the resulting mixture so thoroughly that the lime and magnesia compounds that were dissolved in the hard water are quickly thrown out of solution in the form of a white precipitate.

3d. Separating and collecting this precipitate from the clear softened water.

These mechanical operations should be conducted at a minimum cost and, therefore, the mechanical apparatus should be simple and as nearly automatic as possible; easily adjusted to suit the different waters; not liable to get out of order; be operated without any extra power other than an ordinary pump, such as is used at water stations; so simple that an ordinary pumper can attend to it without neglecting his regular work, and so cheap that the cost of installation does not prohibit its use.

The accompanying drawings illustrate the water purifying apparatus constructed and used by the Chicago & North Western Railway Company.

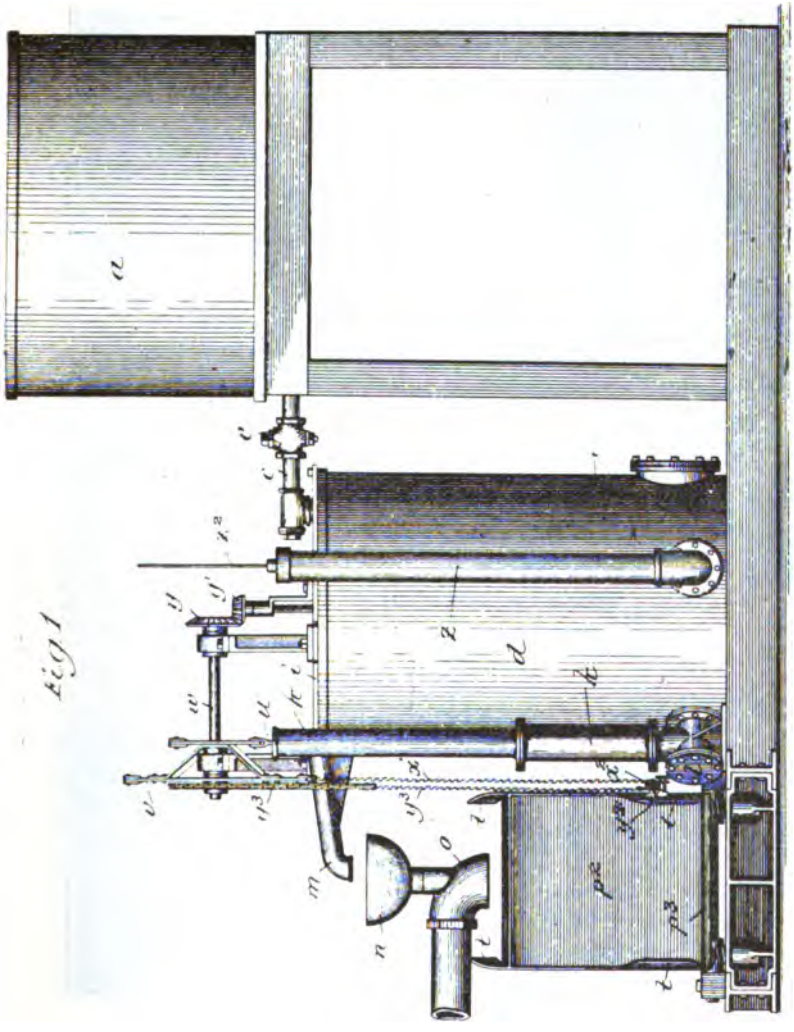


FIG. 45. Apparatus for Softening Water, C. & N. W. Ry.

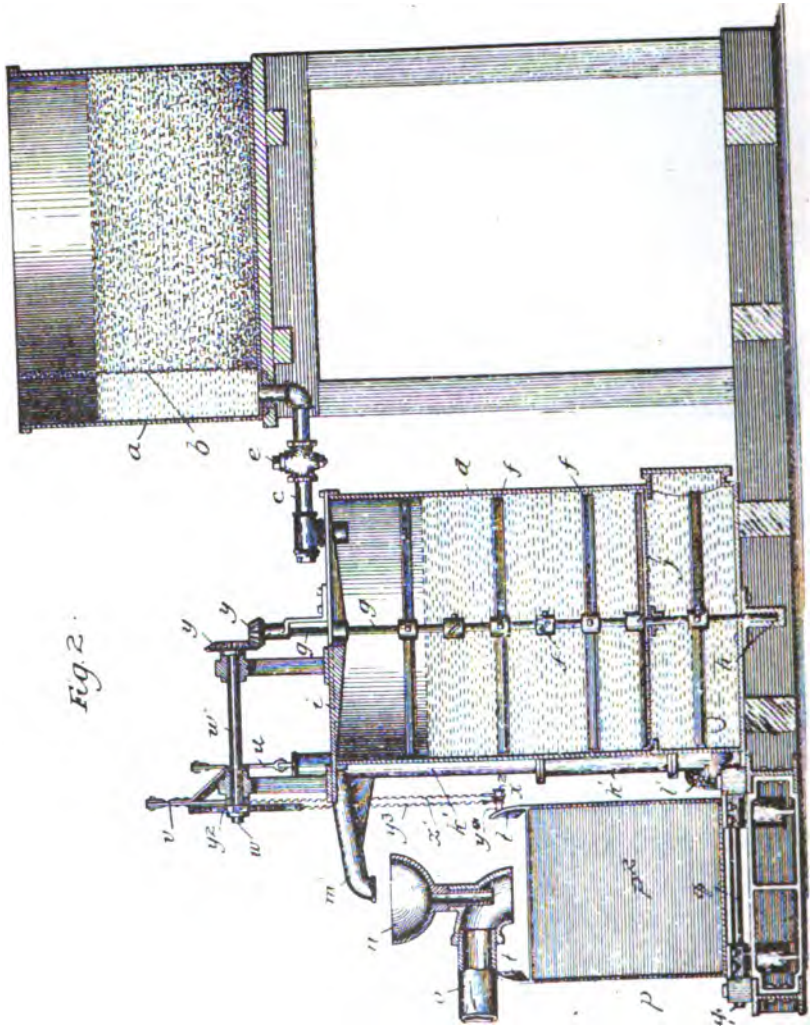


FIG. 46. Apparatus for Softening Water, C. & N. W. Ry.

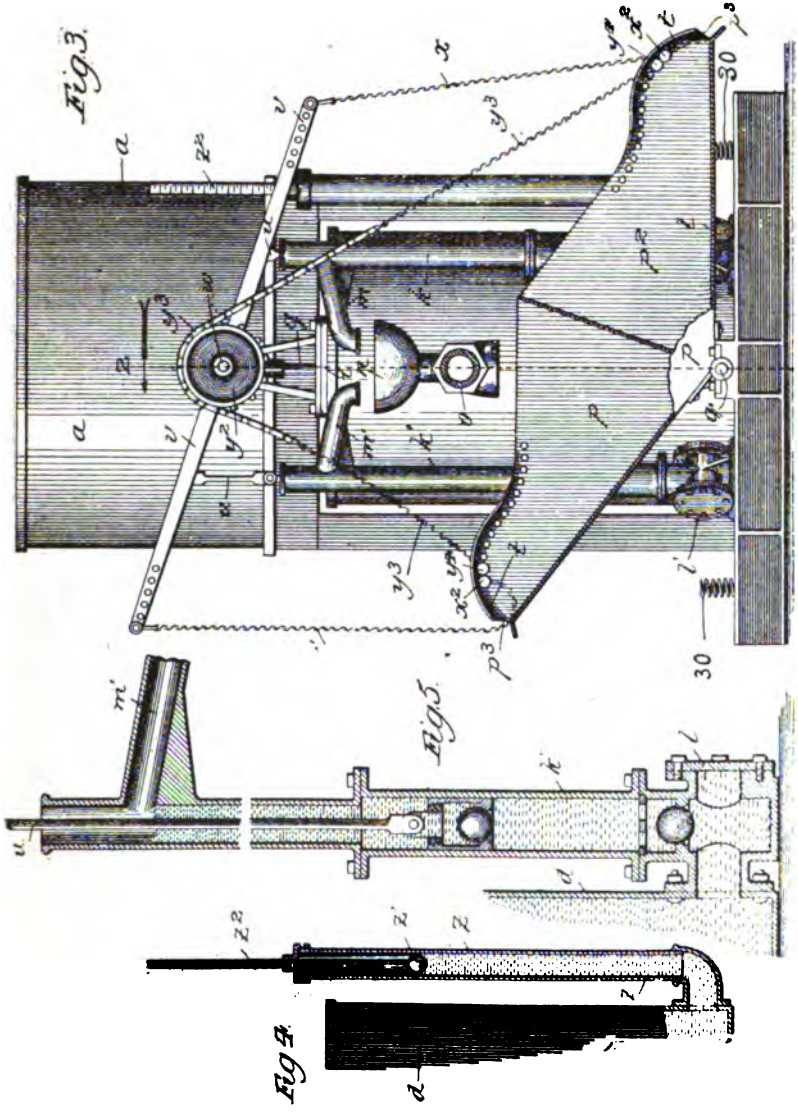


FIG. 47. Apparatus for Softening Water, C. & N. W. Ry.

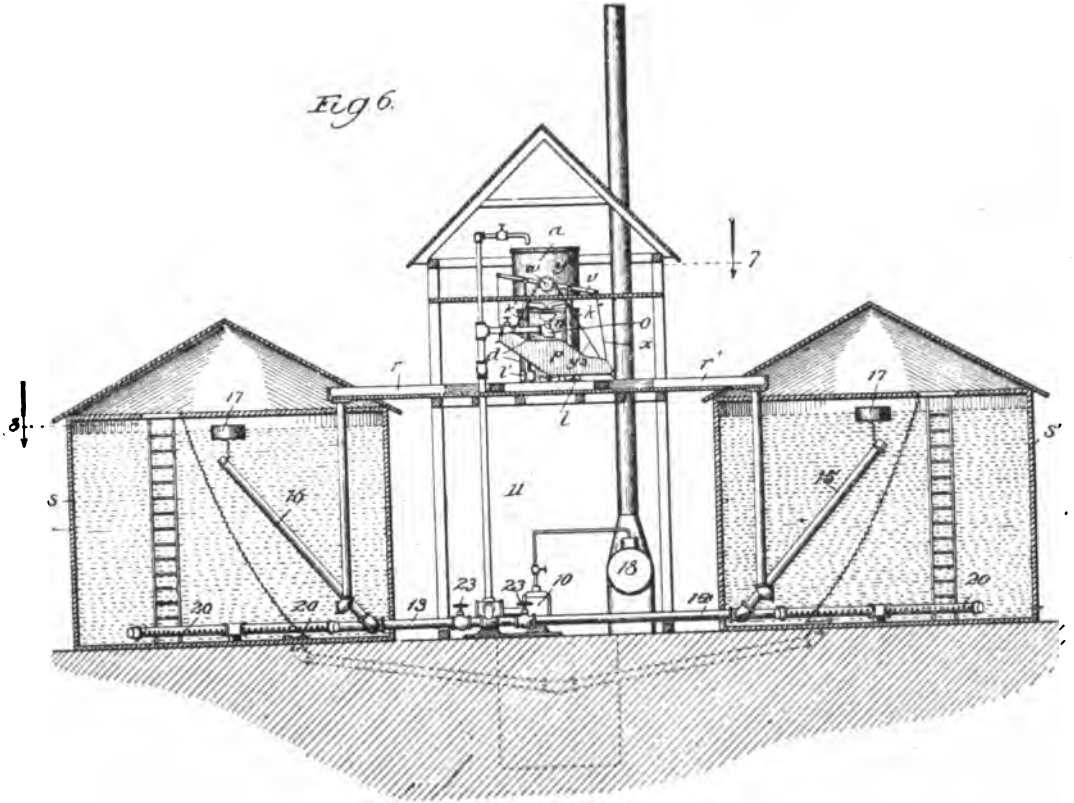


FIG. 48. Apparatus for Softening Water, C. & N. W. Ry.

Fig. 7.

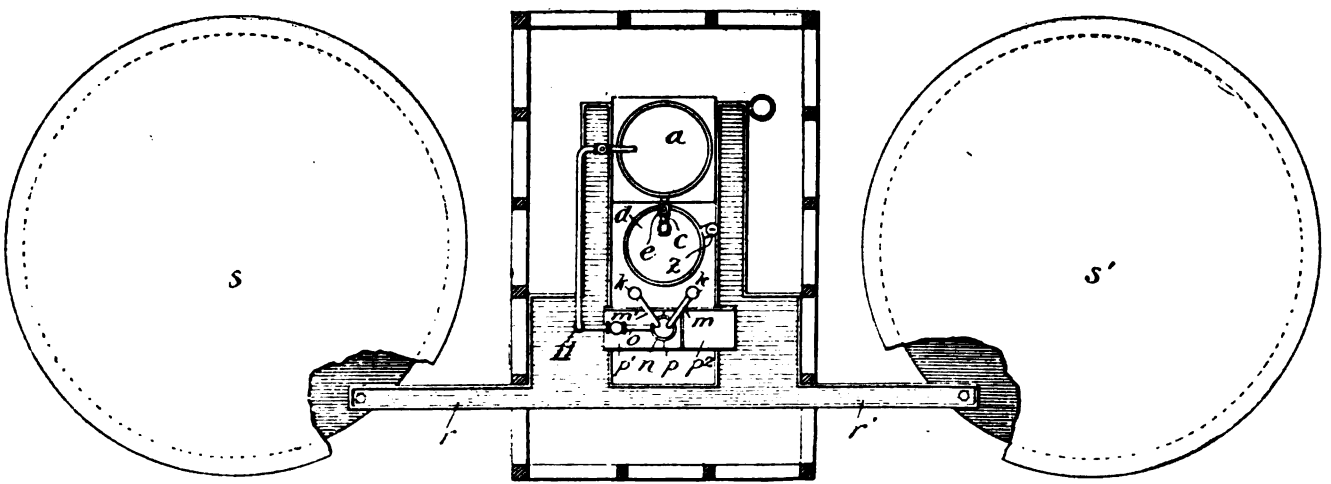


FIG. 49. Apparatus for Softening Water, C. & N. W. Ry.

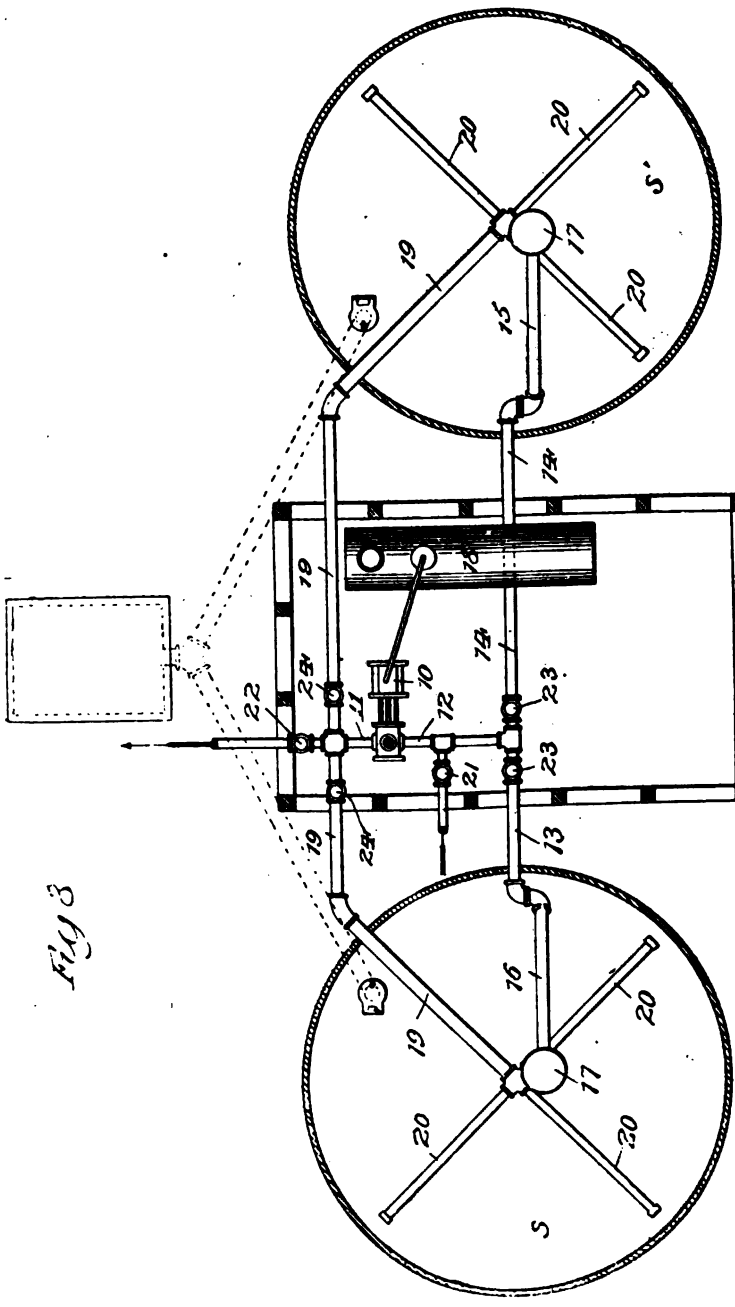


FIG. 50. Apparatus for Softening Water, C. & N. W. Ry.

Fig. 1 is a side elevation showing the arrangement of the different parts.

Fig. 2 is a section of same.

Fig. 3 is an end elevation of same.

Fig. 4 is an elevation partly in section, showing the float and gauge for measuring the depth of chemical solution in the chemical tank.

Fig. 5 is an enlarged vertical section of one of the pumps, showing the arrangement of ball valves and connection of the pump to the chemical tank.

Fig. 6 is sectional elevation of the settling tanks and pump house, showing the location of the entire apparatus for storing, feeding, mixing and settling the water.

Fig. 7 is a plan sectional view showing the wooden box into which the apparatus discharges, and troughs leading to settling tanks.

Fig. 8 is a plan sectional view showing the arrangement of pipes for agitating the old sediment in settling tanks, as described further on.

The primary object of this apparatus is to provide a suitable means for automatically measuring and mixing a predetermined quantity of a standard solution of chemicals with a predetermined quantity of hard water, so that the compounds of lime, magnesia and other scale-forming matter that are dissolved in the hard water may be thrown out of solution by the action of the chemicals.

The secondary object is to provide means for separating the suspended scale-forming matter after it is thrown out of solution and delivering clear soft water to the storage tank from which locomotives are supplied.

The operation of the apparatus is as follows:

The proper quantity of chemicals, usually lime and soda ash, having been determined, they are weighed out and dumped into the mixing vat "a" (see Fig. 2) where they are mixed and dissolved in a proper quantity of water to make the solution the strength desired. By opening the valve "e" this solution is allowed to run into the chemical tank "d." To thoroughly mix and keep the solution stirred up in the chemical tank "d," stirring blades are fixed on the vertical shaft "g," which rotates in the center of this tank. In order to measure and deliver predetermined quantities of the chemical solution, the chemical tank "d" is provided with two pumps "k" and "k^1" (see Fig. 3) connected at the lower portions to the chemical tank "d," through the T's "l" and "l^1." The upper portions of these pumps have discharge pipes "m" and "m^1" which discharge into a funnel "n," attached to an elbow terminating on the hard water supply pipe, so that just before the hard water passes out of this pipe the chemical solution is mixed with it.

To obtain the best results it is essential that the quantity of

the standard chemical solution and hard water be mixed in proper proportions and also that this be done regularly whenever the apparatus is being used, also that it be done economically. To do this a tilting vessel "p" (see Fig. 3) is used. It is supperted on a shaft "q," which is located directly under the elbow from which the mixed hard water and chemical solution is discharged.

This tilting and measuring vessel is divided into two compartments of equal capacity, "p^1" and "p^2." When it is in the position shown in Fig. 3, the mixture of hard water and chemicals falls from the discharge elbow "o" into the compartment "p^1." When this compartment is nearly filled it counterbalances the weight of the other compartment "p^2," so that the vessel tilts until it strikes the springs "30," emptying the contents of the compartment "p^1" and at the same time bringing the other compartment "p^2" under the discharge elbow "o." When this in turn is filled it reverses the movement of the tilting vessel "p," emptying the contents of the compartment "p^2" and bringing the compartment "p^1" again under the elbow "o." For convenience these compartments "p^1" and "p^2" are made such size that 100 gallons of water are required to fill them to the point where they commence to tilt and empty their contents.

Having determined the amount of a standard solution of chemicals required to precipitate the scale-forming compounds from say 100 gallons of any hard water, it is necessary to mix it with the 100 gallons of hard water in one of the compartments "p^1" or "p^2." This is done by regulating the length of the stroke of the pumps "k" and "k^1" which pump the standard chemical solution from the tank "d" into the funnel "n." These pumps "k" and "k^1" are operated by the tilting vessel "p" in the following manner:

The plungers "u" are connected to a walking beam "v" which is rotably mounted on the shaft "w." The ends of this walking beam are connected by means of the chains "x" and "x^1" with studs "x^2" on each end of the tilting vessel. An examination of the drawings, particularly Fig. 3, will show that if the parts are in the position shown in Fig. 3, when the tilting vessel "p" is tilted downwardly to the left, the plunger of the pump "k" is raised so that a quantity of the standard chemical solution is delivered into the funnel "n" and flows with the hard water into the compartment "p^2." When 100 gallons are in it the tilting vessel "p" operates in the opposite direction, causing the other pump "k^1" to operate, and delivers a quantity of the standard chemical solution into the funnel "n," from whence it flows with the hard water into the compartment "p^1." It will be understood that the hard water is running constantly through the elbow "o" and that the two pumps "k" and "k^1" are intermittent in their action. The quantity of the standard chemical solution delivered at each

stroke of these pumps is regulated by the length of the strokes. This can be adjusted by the length of the chains "x" and "x^1" so that a predetermined quantity of chemical solution will be delivered at each stroke. From the above description it will readily be seen that a fixed quantity of chemical solution is discharged into the elbow "o" and flows with the hard water into each compartment of the tilting vessel "p," in proportion to the amount of hard water that is required to cause this vessel to tilt.

It is desirable to automatically and economically operate the vertical shaft "g" in the chemical tank "d" (see Fig. 2) so that the horizontal blades attached to it will keep the chemical mixture thoroughly agitated. To do this it is geared to the horizontal shaft "w" by the pinions "y" and "y^1." The other end of the horizontal shaft "w" is provided with a sprocket wheel "y^2" (see Fig. 3) around which a link belt chain passes, the ends of this chain being attached to the ends of the tilting vessel by the studs "y^4." It will readily be seen by this arrangement that whenever the tilting vessel "p" moves, the stirring blades attached to the vertical shaft "g" in the chemical tanks also move, thus agitating the chemical mixture in the tank "d."

For convenience in measuring the height in the tank of this chemical mixture, a pipe "z" (see Fig. 4) is attached to the side of tank "d" near its bottom. In this pipe is a float "z^1" attached to a graduated scale "z^2" from which can be read the quantity of liquid in the tank "d."

The above described apparatus automatically mixes the proper quantity of the chemical solution with each 100 gallons of hard water delivered by the steam pump and utilizes the weight of the water to furnish power to operate it. The result of this mixture is that the scale-forming matter that was in solution in the hard water is thrown out of solution, but remains in suspension in the treated water. This is separated from the treated water in the following manner:

By referring to Fig. 6 it will be seen that the apparatus is located in the second story of the pump house and that the pump house is located between two tanks placed on the ground. Fig. 7 shows a plan of the second story of the pump house. It will be seen from this that the tilting vessel above described empties its contents into a wooden box which is provided with troughs "r" and "r^1" leading to the two settling tanks. These troughs are provided with shut-off gates so that the water can be run into which ever tank is desired. Fig. 6 shows a sectional elevation of these tanks. It will be seen that the troughs "r" and "r^1" empty their contents into vertical pipes that extend to the bottom of the tanks and terminate in elbows. The object of this arrangement is to stir up as much as possible the old precipitate that remains in the tanks from former treatments, in order to hasten the settling of the new

precipitate. It is a well known fact that if the old precipitate is stirred up well, the new light particles become attached to the old heavier particles and settle quickly.

After these tanks are filled or partially filled with the treated water holding the new precipitate in suspension, it is desirable that the sediment from former mixtures be thoroughly agitated and mixed in the settling tanks in order to hasten the settling of the new precipitate. To accomplish this result the same steam pump is used that was used for pumping a supply of water into the main. This pump has its inlet 12 (see Fig. 8) connected to branch pipes 13 and 14, leading into each of the settling tanks. These branch pipes have their outer ends 15 and 16 jointed to the main portions thereof, so as to be swiveled thereon. Floats 17 (see Fig. 6) are secured to each of these inlet ends of the branch pipes 15 and 16 to maintain their inlet-openings at or near the level of the liquid. The discharge pipe 11 of such pump is also connected with branches 19, which extend into each of the settling tanks, and such branches are also connected to perforated pipes 20, which rest at or near the bottom of such tanks.

The operation is as follows: The valves 21 and 22 (see Fig. 8) on the ordinary inlet and discharge pipes, which are used when the mixing apparatus above described is in operation, are closed, while valves 23 and 24 on the inlet and outlet pipes just above described are opened. The pump is then started and the mixed treated water and precipitate at or near the top of the settling tank is drawn into the pump through the pipes 13, 14, 15, and 16, and forced into the bottom of the settling tank through perforated pipes 19 and 20, thereby maintaining a circulation of such liquid in such tanks, and stirring up the sediment from former treatments. After the contents of the tanks have been agitated for a few minutes they are allowed to stand until the sediment has settled. The purified water is then taken from the settling tanks through the pipes 15 and 16, attached to the floats 17, and transferred to a suitable storage tank, or it may be drawn direct from the settling tanks to the boiler.

By examining the location of the valves 23 and 24 (see Fig. 8) it will be seen that when all four of them are open, circulation can be carried on in both tanks at the same time, and that by closing one pair of them the circulation can be confined to one tank only.

CAPACITY.

The same size apparatus is used for all plants.

The capacity of this apparatus is almost unlimited. The number of oscillations of the tilting vessel "p" is determined by the amount of water that can be pumped into it so that if settling capacity is provided, the capacity of the apparatus depends entirely upon the capacity of the steam pump.

In regard to settling capacity.—It has been found by using

tanks 30 feet in diameter and 16 feet high, that each tank can be filled with treated water, the precipitate allowed to settle, and the clear softened water transferred to the railway supply tanks in 12 hours. These tanks have a capacity of 77,000 gallons, but as a certain quantity of water is left in these with the sludge, their net capacity is about 60,000 gallons of softened water each 12 hours, or 120,000 gallons per tank per 24 hours.

REMOVAL AND USE OF SLUDGE.

Once a month it is necessary to remove the sludge that has collected in the bottom of the settling tanks. When the softening plants are located near a drain the removal of the sludge is a very simple proposition. It is then only necessary to open the valves in the bottoms of the settling tanks and allow the sludge to run into the drain.

In several cases the plants are not located convenient to drains. It then is necessary to carry this sludge away. Several methods have been tried. One was to dig a hole in the ground near the settling tanks, allow the sludge to run into it, and after the excess water had soaked into the surrounding soil, to shovel the thick sludge out and carry it away. Another was to allow the sludge to run into a large box mounted on a flat car standing on a depressed track located near the settling tanks. This car was then taken to a nearby dumping ground and the sludge allowed to run out. Still another was to pump the sludge from the settling tanks into a box mounted on a flat car standing on a track at the ground level. Still another was to run the sludge into barrels and ship it to various points where it was used.

Up to the present time the only use found for this sludge is for making whitewash. For this purpose it works very well. On account of its firmness and freedom from grit, it is especially adapted for use in a whitewash spraying machine. Last summer the wing fences, telegraph poles, stock yard sheds, etc., etc., of the Iowa division of the C. & N. W. Ry. Co. were whitewashed with it. This winter the interiors of the shops at Chicago were covered with it.

Experiments are being made to ascertain its value as one of the components of boiler lagging. It is expected that other uses will in time be found for it.

ACTUAL RESULTS OBTAINED.

The first of these machines constructed was installed at Council Bluffs, Iowa.

The water at this point is obtained from four pipes, four inches in diameter, driven into the ground about 70 feet. The apparatus was started July 30th, 1902, and has softened all the water used by locomotives at that point ever since.

This water untreated is an unusually poor one for boiler use. Several years ago an attempt was made to use it without treatment, but after a few months' trial it caused so much trouble that it was abandoned. The analyses of this water, before and after treatment, is as follows:

COUNCIL BLUFFS, IA., WELLS 70 FEET DEEP.	GRS. PER GALLON.	
	Before treatment.	After treatment.
Total solid matter	53.65	31.35
This solid matter consists of:		
Carbonate of lime	24.39	2.26
Carbonate of magnesia	1.13	0.88
Sulphate of lime	6.22	.....
Sulphate of magnesia	13.33	.....
Oxides of iron and aluminum	0.34	0.02
Silica	1.42	0.38
Incrusting solids	46.88	3.54
Alkali chlorides	1.21	1.27
Alkali sulphates	5.58	26.32
Non-incrusting solids	6.79	27.81
Pounds of scale-forming matter in 1,000 gallons	6.69	0.51

The plant at Denison has been in operation about a month. The following are the results of analyses of the water at this station before and after treatment:

DENISON, IOWA, WELL 25 FEET DEEP.	GRS. PER GAL.	
	Before treatment.	After treatment.
Total solid matter	24.19	16.50
This solid matter consists of:		
Carbonate of lime	14.68	2.16
Carbonate of magnesia	2.51	2.05
Sulphate of lime	3.60	.....
Sulphate of magnesia	1.20	.....
Oxides of iron and aluminum	0.09	0 06
Silica	0.96	0.86
Incrusting solids	23.04	5.13
Alkali chlorides	1.15	2.38
Alkali sulphates	.....	7 77
Alkali carbonates	.....	1.22
Non-incrusting solids	1.15	11.37
Pounds of scale-forming matter in 1,000 gallons	8.29	0.73

The plant at Dunlap has been in running order only a few days, so we have not yet adjusted the formula to reduce the scale-forming matter as low as we will after a week or so.

The following are the results of analyses of the Dunlap water before and after such treatment as we have given it up to date:

*Dunlap, Iowa, Well 28 Feet Deep.	Grs. per Gallon.	
	Before treatment.	After treatment.
Total solid matter	40.42	23.31
This solid matter consists of:		
Carbonate of lime	16.11	1.71
Carbonate of magnesia	2.25	1.41
Sulphate of lime	5.41	2.22
Sulphate of magnesia	9.92	1.00
Oxides of iron and aluminum	0.16	0.18
Silica	1.52	0.38
Incrusting solids	35.37	6.90
Alkali chlorides	2.06	2.03
Alkali sulphates	2.99	14.38
Non-incrusting solids	5.05	16.41
Pounds of scale-forming matter in 1,000 gallons	5.05	0.98

At Boone and Carroll the softening plants have just been completed and will be put in operation as soon as we can get a supply of lime and soda ash delivered there.

At West Side we have a softening plant in operation, using the same chemical process as the others, but the mechanical apparatus used at this plant was designed by Mr. H. Stillman, of Sacramento, Cal. The following are the results of analyses of this water before and after treatment:

West Side, Iowa, Well 28 Feet Deep.	Grs. per Gallon.	
	Before treatment.	After treatment.
Total solid matter	51.33	28.18
This solid matter consists of:		
Carbonate of lime	17.32	2.67
Carbonate of magnesia	11.70	.....
Sulphate of lime	11.55	.....
Sulphate of magnesia	1.09	1.54
Oxides of iron and aluminum	0.64	trace
Silica	1.55	0.54
Incrusting solids	43.85	4.75
Alkali chlorides	6.32	3.42
Alkali sulphates	1.16	20.01
Non-incrusting solids	7.48	23.43
Pounds of scale-forming matter in 1,000 gallons	6.26	0.68

In addition to the six softening plants we now have completed, we are erecting eleven more plants at the following

stations, viz. : Missouri Valley, Grand Junction, Ames, Tama, La Moille, Belle Plaine, Beverly, Lisbon, Stanwood, Lowden, and De Witt.

Most of these are now rapidly approaching completion. Two of them, viz. : Grand Junction and Belle Plaine will be ready for the installation of the machinery this week.

At our Chicago shops we are building 25 of the machines described in this paper, which we propose to install as fast as completed. We are confident that we have passed the experimental stage of water softening, and that in the near future we will remove the lime and magnesia compounds from most of our poor water before they are used in our locomotive boilers instead of allowing these compounds to be deposited on the inside of the boilers in the form of scale. Briefly stated, we propose to take the scale-forming matter from the water in the shape of a fine white powder and use it for whitewash and perhaps other purposes instead of allowing it to incrust the flues and sheets of the boilers, and then remove it in the shape of hard scale.

On the insert, the stations where we have completed water-softening plants are indicated by a circle ○, and the stations where we are now erecting plants by a square □.

PRACTICAL RESULTS IN LOCOMOTIVE BOILERS.

About 35 locomotives take water at Council Bluffs in 24 hours. Most of these are road locomotives, and as they also take water at other stations it is almost impossible to get definite information in regard to the use of the treated water in them other than the opinions of the engineers as to how it acts in the boilers. Their reports have been favorable. Three switch locomotives, however, are worked constantly at Council Bluffs, and have used nothing but this purified water since July 30, 1902. A day or two after they commenced to use it the flues commenced to leak. They were taken into the roundhouse, and the flues rolled, and since that time have not leaked nor have they given any trouble. The old hard scale that was in these locomotive boilers is being loosened up by the purified water, and comes out in large pieces whenever the boilers are washed out. No new scale has formed. The foreman in charge of the roundhouse at Council Bluffs, under date of January 3, 1903, wrote to his superior officer as follows:

"Before using the purified water we had a great deal of flue work on our switch engines, especially the engines doing the heavy work, and will state that we are not doing one quarter of the boiler work now on these engines that was done prior to using the purified water, and our switching engines are worked very hard at present. I am sending to you under separate cover to-day just a few pieces of scale that I picked up after washing out engine 171. Engine 1,058 has but very little scale in her boiler, and engine 847 about the same. For the past two

months engine 1,058 has had no boiler work done on her, and engines 171 and 847 have had but little done. These engines are out all the time except when we hold them in once a week for washing out. I am very well satisfied with the water, and believe that when once we get the old scales all removed from these engines, calking of any description will be done away with."

COST OF TREATMENT.

General statements as to the cost of softening water are often misleading. The chemical process is an exact one. To remove a fixed quantity of carbonate of lime from water requires a fixed quantity of slaked lime, and to remove a fixed quantity of sulphate of lime requires a fixed quantity of soda ash. If more is added, it is wasted; if less, the softening is not completed. Therefore, when comparing figures showing the cost of softening water the following items should also be compared:

1st. *The character of the scale-forming matter that the hard water contains* If a water is hard because it contains sulphates, it costs more to soften than it does water whose hardness is due to carbonates. To remove carbonate of lime only costs very little. To remove sulphate of lime costs much more. It has been estimated that the hardness due to sulphates is nine times as expensive to remove as that due to carbonates.

2d. *The quantity of the scale-forming matter that the hard water contains.* If a hard water contains a large quantity of scale-forming matter, it necessarily requires the use of more chemicals than one containing a small quantity.

3d. *The degree to which the purification is carried.* If only half of the scale-forming matter is removed, it requires only half the quantity of chemicals that it would if all of it was removed.

4th. *The cost of the apparatus.* The simpler and cheaper the apparatus, the better it is, provided the efficiency is not sacrificed. If the results obtained by a simple and inexpensive apparatus are satisfactory, there is no necessity for using a complex or expensive apparatus.

5th. *The cost of operation.* If the apparatus requires the use of an engine or motor to operate it, or consumes much steam, the cost is increased.

6th. *The cost of labor.* If the apparatus requires the attention of skilled labor, or even of much unskilled labor, it increases the cost.

The apparatus I have described is simple and inexpensive. It is so nearly automatic that it is only necessary to weigh, dissolve, and mix the chemicals, and allow them to run into the chemical tank. This is done by an ordinary pumper without interfering with his regular work. It does not require any extra power to operate it. The results of analyses of the water, before and after treatment, show that the treatment is effective,

and practical results from the use of the treated water show that it is beneficial to the boilers.

With this apparatus the cost of treating waters will vary from a minimum of about 1 cent per 1,000 gallons for a fair boiler water, to a maximum of say 10 cents per 1,000 gallons for a water that is so bad that an attempt to use it untreated in boilers would result in so much trouble and expense as to practically debar its use.

SUMMARY.

The salient points that I have endeavored to bring out in this paper are as follows:

1st. Scale, deposited from water, on the inside of boilers, is the cause of much trouble and expense.

2d. Water as it falls on the earth does not contain any scale-forming matter.

3d. The amount and character of the scale-forming matter in water varies greatly and depends upon the character of the soil and rock through which it passes.

4th. Scale-forming matter can be removed from water before it is used in boilers by simple chemical processes and inexpensive mechanical apparatus.

5th. Ninety-eight per cent of scale in boilers is derived from carbonates and sulphates of lime and magnesia.

6th. Carbonates of lime and magnesia are thrown out of solution by boiling. They, alone, form soft scale.

7th. Sulphate of lime requires a boiler pressure of about 55 pounds to throw it out of solution. It forms hard, compact scale.

8th. Sulphate of magnesia is decomposed in a boiler, forming hydrate of magnesia and sulphate of lime. These make a very hard, brittle scale.

9th. Carbonates of lime and magnesia can be thrown out of solution in cold water by adding to the water any chemical that will absorb the carbonic acid gas that holds them in solution. Slaked lime is the cheapest.

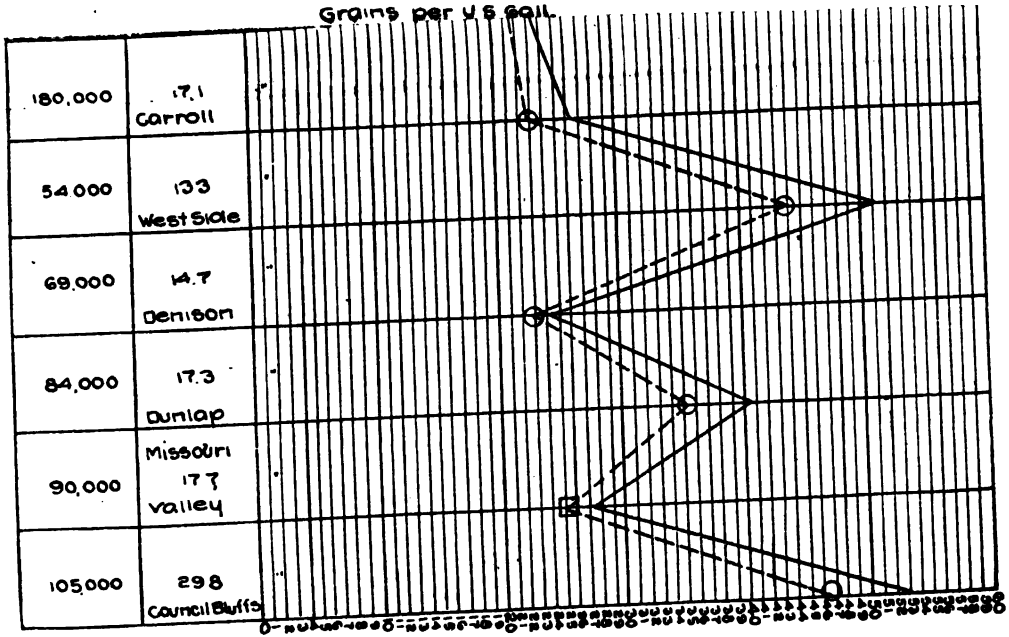
10th. Sulphates of lime and magnesia can be thrown out of solution in cold water by decomposing them with various chemicals. Carbonate of soda is the cheapest.

11th. The use of boiler compounds in boilers is not advisable. The proper time to remove scale-forming matter from water is before it enters the boiler.

12th. Hard water that is very poor for boiler use can be softened and made good for boiler use at a cost that is only a small per cent. of the expense of using the hard water untreated.

CONCLUSION.

I trust that I have made clear the fact that the treatment of boiler water to remove scale-forming matter from it before it enters the boiler can be easily and economically done, and that


Grains per U.S. Gall.
180,000
17.1
Carroll
54,000
133
West Side
69,000
14.7
Denison
84,000
17.3
Dunlap
90,000
Missouri
17.7
Valley
105,000
29.8
Council Bluffs
0

the problem is not such a difficult one but that it can be conducted in a practical manner without any secret or mysterious process.

In these days of low rates and keen competition railroad companies are obliged to curtail operating expenses to a degree that was not considered possible a few years ago. The result of a careful study of the water supply of any railroad will convince its operating officers that much money can be saved and trouble avoided by improving the character of many waters that are used in its locomotive boilers.

I predict that the day is not far distant when the use of hard water in locomotive boilers will be a thing of the past, and that water-purifying plants will be as essential for modern railroads as modern locomotives, modern cars, modern shops, and modern methods of conducting transportation.

APPENDIX.

During the presentation of the above paper on Water Purification, experiments were made showing the effect of mixing water containing scale-forming matter in solution with chemicals. In one of these, a sample of clear water, which contained carbonate of lime in solution, was poured into a tall glass cylinder; to this was added a clear water solution of common building lime. The result was that the carbonate of lime that was in solution in the water was immediately thrown out of the solution and settled in the bottom of the cylinder, leaving clear, soft water above it. This experiment was made to illustrate how carbonate of lime can be removed from water before it is used in a boiler by simply mixing it with a water solution of lime.

Another experiment was made to illustrate how sulphate of lime can be removed from water before it is used in a boiler by simply mixing it with a small quantity of carbonate of soda. A sample of water containing sulphate of lime was put into a glass cylinder, and a few drops of a water solution of carbonate of soda added to it. The result was that the sulphate of lime was decomposed and thrown out of solution. It settled to the bottom of the cylinder, leaving clear water, free from sulphate of lime, in the upper portion of the cylinder.

Several samples of scale that had been removed from boilers were exhibited and explained. A photographic reproduction of these exhibits is shown herewith.

No. 1 shows a soft, bulky scale derived from a water which contained carbonate of lime, alone.

No. 2 shows a hard, thick scale derived from a water containing sulphate of lime. Several samples of it are 1¼ inches thick.

No. 3 shows semi-cylindrical pieces of hard scale which have been broken off from flues. They are ⅜ of an inch thick.

No. 4 shows small pieces of scale removed from switch engines

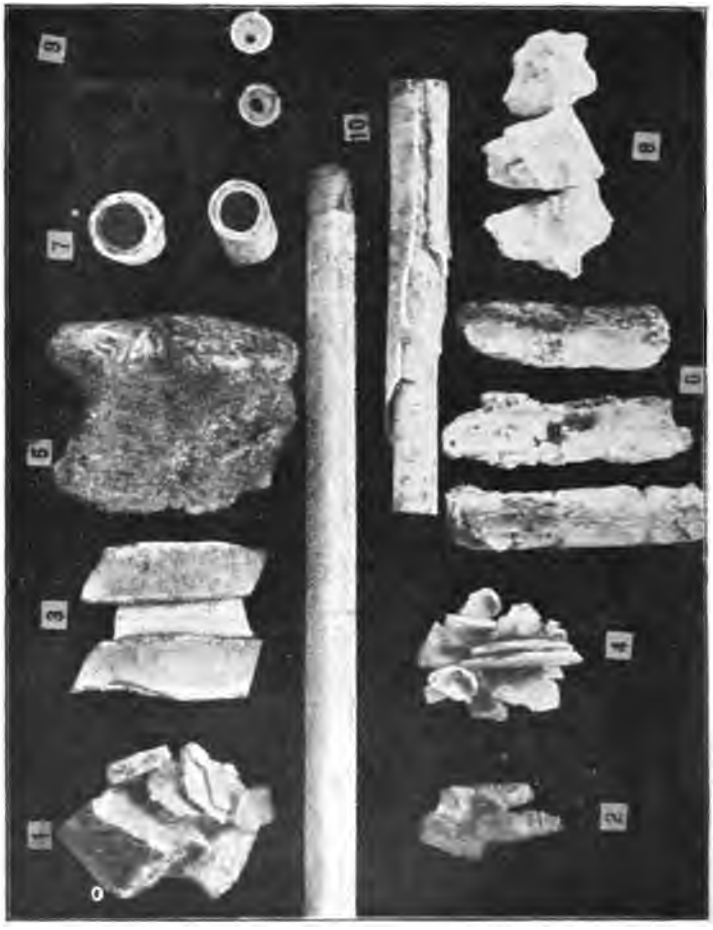


FIG. 52. Showing Scales removed from Boilers, C. & N. W. Ry.

at Council Bluffs, by the use of treated water in their boilers. It will be seen that some of them are cup-shaped, having been deposited over rivet heads, others are partially cylindrical, having been deposited around stay bolts.

No. 5 shows a large piece of scale representing a portion of a lot that was removed from a boiler.

No. 6 shows samples of scale which were deposited around flues. Some of them are $\frac{1}{8}$ of an inch thick.

No. 7 shows pieces of flues coated with a hard, compact scale. On one flue this was $\frac{1}{8}$ of an inch, and the other $\frac{1}{4}$ of an inch thick.

No. 8 shows samples of the dried white precipitate removed from water by the treatment described in the attached paper.

No. 9 shows locomotive feed pipes which are nearly filled with scale. The opening for the passage of water in one of these is only $\frac{1}{4}$ of an inch, and in the other it is $\frac{1}{2}$ of an inch in diameter.

No. 10 shows two long pieces of flues covered with scale. On the longer piece the scale adhered to the flue so tightly that it was necessary to use a cold chisel and hammer to remove it from the end of the flue shown near the figures 10.

THE PRESIDENT: I believe we have all been very much interested in Mr. Davidson's very valuable paper, and I have no doubt many of you are anxious to ask questions, to criticise, or to add to the information presented. The discussion of the paper is now in order.

MR. A. R. RAYMER (P. & L. E. R. R.): I have followed Mr. Davidson's paper with a great deal of interest, as the matter of treatment of water is one that is giving us much concern on our road.

There is one feature of the problem which I would like to ask Mr. Davidson to explain in regard to the concentration of sulphate of soda in the boiler. Does he have any trouble from foaming? He has stated that he washes out the boilers using treated water frequently. Is this done to remove the sulphate of soda or to remove loosened scale?

MR. DAVIDSON: I will say that the object of washing the boilers is, at the present time, to get the old scale out; it is gradually coming out. After the old scale is removed we will not wash boilers out so often, because we will then only have in them a light deposit of carbonate of lime which will pass out easily when the boilers are emptied. We can soften the water so that it will contain only 3 to 4 grains of scale-forming matter per gallon. We do not think it necessary or advisable to do this; we think if we reduce the scale-forming matter down to 5 to 7 grains per gallon that we will have no trouble, and we will get satisfactory results in boilers.

In regard to sulphate of soda in a boiler: If the engineer will use his blow-off cock and then remove the concentrated water once in a while there will be no trouble from sulphate of soda.

If, however, he does not use the blow-off cock but lets the water concentrate in the boiler, he undoubtedly will have trouble from foaming, if the sulphate of soda is there in excessive amounts.

THE PRESIDENT: Mr. Manchester, you have all kinds of good and bad water on the Milwaukee road, have you anything to say in reference to the matter?

MR. A. E. MANCHESTER (C., M. & St. P. Ry.): It appears to me that Mr. Davidson has about said it all. We all have our troubles with bad waters, and it has been one of the vexed questions that we have had to deal with for a good many years. The Chicago, Milwaukee & St. Paul Ry. has been one of the pioneers in the line of undertaking to treat water. We have done our work in the locomotive tender, and with some fairly good results, although I have always believed that better results could be obtained by treatment at the roadside tank for the poorer water. Yet I will say to anybody who has not made an effort in that direction that it will not pay them to wait until they can get up an equipment before making an effort in purifying water; I believe they would better commence it at once. I am looking into the question now of the use of purification plants for some of our worst waters, and expect to get results.

There is one point that I would like to ask Mr. Davidson in connection with this, and that is relative to the use of lime. He said that in the use of lime, if you put in too little you fail to get the full result; if you put in too much you have wasted it. Is there anything else that would be the result if you put in too much lime? Would not the putting in of too much lime re-harden the water?

MR. DAVIDSON: I do not believe that putting in too much lime would re-harden the water, but it would make the water very caustic and would make it attack the boiler plates. You cannot get much carbonate of lime in solution unless you have carbonic acid gas to hold it there. If you put in lime and absorb the carbonic acid gas you cannot get more carbonate of lime in solution, but you can make your water very caustic and make it bad for the interior of your boiler.

MR. D. VAN ALSTINE (C., G. W. Ry.): I would like to ask Mr. Davidson what is tri-sodium phosphate; what are the ingredients?

MR. DAVIDSON: Tri-sodium phosphate is something I have never used; there is no doubt a great many gentlemen here who have used it, and probably are better posted than I am.

R. QUAYLE: He is simply asking the question "What is tri-sodium phosphate?" We want to know what it is.

MR. DAVIDSON: It is just what its name says it is; I do not know as I can put it in English any better than to give it its regular name.

MR. VAN ALSTINE: What part of the incrusting solids does it act on?

MR. DAVIDSON: I really have had no experience with the trisodium phosphate, and I do not feel like discussing it.

MR. J. H. WINNE (Illinois Central R. R.): I would like to ask if it is not necessary to interpose an additional pump there for re-handling that water after it has been treated?

MR. DAVIDSON: It is not. We can do it all with one pump.

MR. H. E. SMITH (L. S. & M. S. R. R.): I was very much interested in the matter of mixing water with the chemicals. In the early days of water softening there was a great deal of difficulty encountered because not sufficient care was taken in this particular, both in making up the solutions and in mixing them with the water. Sometimes the solutions were not of proper strength, sometimes they were added in incorrect proportion because the valves or other apparatus to feed them were not sufficiently well designed.

I have watched this apparatus that has been described and was impressed with one thing which is not emphasized in the paper, and that is the thorough stirring that the water receives in that triangular tipping box. You can readily imagine a five- or six-inch stream of water flowing into a box of the capacity of two barrels, and especially one of that shape, would produce a very violent stirring and thorough mixing; that of course mixes the individual tipperful of water, and the further mixing is completed in the tank, which has been described.

I presume it has been found that the time necessary to complete the reaction and obtain clear water depends somewhat on the water. Possibly the work would be completed with some waters in less time than has been given on account of their more favorable composition, and I am told by those who have had practical experience in the matter that carbonate waters requiring chiefly lime can be treated more rapidly than those containing large amounts of sulphate of lime.

In talking with various people regarding the results in treatment of water based on analysis, I frequently find the result expressed in the percentage of removal of incrusting solids. I speak of this because it sometimes creates a wrong impression. I think it is very easy to see that waters like those on the right hand chart, those very bad waters, can be treated to the extent of 95 per cent., perhaps, of incrusting solids, may be 97 per cent., but it could not be done with these better waters, so that the proper method of rating a process is not by percentages, but by the absolute amount of incrusting solids remaining, as has been done in this paper.

There is one difficulty that I think is likely to arise in some places with water-softening apparatus and processes from the fact that after it is installed and supposed to be in perfect order, and it is in perfect order, in fact, it is left to take care of itself, without occasional supervision by a competent chemist. Locomotives are not handled in that way. There is some one who is constantly looking after the performance of locomotives, and

the same thing I think should be done with water-softening plants. This can hardly be said to be a disadvantage, as supervision of apparatus is something incident to the operation of any machinery or plant of any kind. The benefit to be derived from the use of softened water comes in in the fuel consumption and in repairs, as has been stated; also very often in the avoidance of delays due to holding engines in for repairs, which they do not need when the water is properly treated.

MR. M. E. WELLS (B. & M. R. R.): I know that I have ideas on this subject that are quite different from those ordinarily held, and I almost dislike to express them on account of not having the time to go over this whole subject and giving you my reasons for the few ideas I will express.

I have been doing some work along the line of boilers, and I want to say to you, gentlemen, that while I am not opposed to water purification, I will tell you what I am more in favor of,—that is, taking better care of our boilers. I want to make a statement for you to think about: The proper care of locomotive boilers will do more for the boilers of the United States to-day than water purification will do without proper care.

If you purify water do not get so interested in it that you will overlook taking proper care of your boilers. One gentleman spoke of the sulphate of soda being left in; I wish to say a little about that. Mr. Davidson has shown you a water that before purification has 1.16 grains, and after purification has 20 grains of sulphate of soda. Now, if you were using as much alkali water as we get out west, you would be fighting shy of sulphate of soda, on account of its foaming properties. We have discovered from actual experiment that with about 175. grains of alkali (sulphate and carbonate of soda) to the gallon, our boilers begin to foam; and on account of this we do not like anything that will increase the alkali.

The purification of any water containing a large per cent. of calcium sulphate will always leave you enough sulphate of soda to soon cause foaming. My experience is that we prefer an incrusting water to a foaming water.

I think this subject of water purification has come about from people thinking that the bulk of their boiler troubles is from bad water. Boilers have been shamefully mistreated, and it is not bad water generally, nor poor boiler work, but bad treatment that is the trouble. We started to cool boilers more carefully, in order to effect an equality in contraction, and we find that we have greatly increased the efficiency of our boilers and decreased our boiler work and leakage. And in addition to these benefits we find our treatment followed by a great decrease in incrustation. The more carefully we cooled, the more mud came down. Every one will tell you that the carbonates of lime and magnesia are not incrusting matter, that is, they do not make a hard scale. In boilers properly cooled before the water is let out, the carbonates of lime and magnesia make so small a

per cent. of the scale that you will have no trouble from them. I have followed boilers for two years from the locomotive works whose flues have not been changed in that length of time, and the scale analysis showed sulphates of lime and magnesia in a very thin scale. I want to show you that what I am advocating is to see how well we can do with the boilers with the present waters that we have, by proper care; then I think the majority of you will do so well that you will not be looking for water purification.

MR. C. L. KENNICOTT (Kennicott Water Softener Co.): In these days we are trying, through health journals, through health societies, and organizations of various kinds to keep perfect health, so that the doctors will not have so much to do. The analogy between cleaning the boiler and the doctor trying to tinker up the patient is a true analogy. Let us cure the cause of the trouble, and we will not have the trouble. There is no comparison between the expense of treating the water and the expense of removing the scale from boilers and the lowering of the earning capacity of the locomotive as it lies in the shop in order to cool before washing. If I had any criticism to make upon Mr. Davidson's very able paper—I think the most able paper I have ever heard on water purification—it would be that he did not bring out strongly enough the point that if water is purified, if the boilers are not scaled, if the tubes do not leak; that the engines are not held in the shops, in times like these in particular, when there is probably not a railroad in the country but is trying to obtain more motive power; that they would be able to get more time, more earnings out of the engines which they now have, and they would not need so much more motive power.

Another point that was not emphasized is one that perhaps will cause considerable surprise, and that is, the figures which show the enormous amount of scale-forming material which enters locomotive boilers at a given station. Many stations which are not very important run into the boilers every month 5 to 10 tons of incrusting matter. A single division of some of the Western roads will run into the boilers as high as 90 tons of scale-forming material every month. These figures, which are quite startling, may be easily proven by figuring from the analyses; taking any analysis, divide the number of grains of incrusting solids by 7, will give the pounds per 1,000 gallons; simply multiply this by the number of 1,000 gallons used on a division and you have the pounds of incrusting solids which are entering the boilers on that division.

MR. J. A. CARNEY (C., B. & Q. R. R.): The subject of water purification as Mr. Davidson has presented it to-day is one to which we ought to give a great deal of thought, that is, the purification of water outside of the boiler. I think that nearly every one in this room who is connected with a railroad has tried at odd times the use of chemicals to purify the water in the

boiler and they have failed in every case. There may have been a few cases where there was a little help, but the trouble is this, all that is done in trying to purify the water in the boiler is to change the condition of the scale-forming material ; instead of going into the boiler to make scale on the flues, we introduce it into the boiler as mud ; that, in course of time, bakes on to the flues and the fire-box sheets, forming a soft scale. It is my idea that the only successful and the only way that we ought to try to purify water is outside of the boiler, and before we put it into the engine tank.

A great many of the water supplies in Iowa are more or less muddy, and on the C., B. & Q. Railroad we find less trouble with leaky flues on our Iowa division than we do on the Illinois division, although the amount of incrusting solids in the water is about the same. I attribute it to the fact that the mud which we pump in with the scale-forming material in the water collects the scale, instead of the scale collecting on the flues and on the crown sheets.

At one time I made some experiments to determine the effect of scale of different thicknesses and of different compositions. I had a copper boiler about a foot in diameter that I could get any desired pressure on, and I put into this boiler artificially hard waters and tried to get scale. My experiments were conducted for some time, and all I succeeded in getting was a very nice quality of mud. I could not understand why I did not get scale. Finally, I filtered the water very carefully and heated it slowly and in that way got a nice and firm scale on this copper boiler. That led to a further investigation in regard to boiler waters, and I found, as I say, through the Iowa lines where we have muddy water, that we did not get as much accumulation of hard scales on the flues.

In regard to the defects of this particular purification, and the fact that the water is not made absolutely pure, I think that is rather a good point. I believe that if we could put distilled water into our boilers, that we would have a great deal of trouble from corrosion. I know in one of the office buildings here in Chicago where in the heating system they use water condensed from steam, that they have a great deal of trouble from corrosion, which was due to nothing more or less than distilled water, so that the small amount of scale-forming material, and which is so small that it has very little effect on the boiler, is rather to its betterment than to its detriment.

In regard to what Mr. Wells said on the care of boilers, we will agree with him there, but the care of a boiler is largely determined by the number of times you have to wash it out, and if by the use of water purification you can reduce the number of times that the boiler has to be washed out, the care of the boiler is so much improved.

Another thing that Mr. Wells touched on was sulphates. There are two kinds of sulphates, one sulphate of sodium, and

the other sulphate of calcium. The sulphate of sodium is soluble in water and cannot be precipitated. It gives a great deal of trouble in foaming and from corrosion also. It is a very different substance from sulphate of calcium which forms scale. I think the presence of sulphate of calcium is a great deal more harmful to the boiler than large quantities of sulphate of sodium, provided it does not run, say, above 150 grains per gallon. You can remove sulphate of sodium from the boiler, either with the use of the blow-off cock, or by washing it out, but sulphate of calcium, when it is once precipitated on the flues or fire-box, cannot be removed without great difficulty.

Mr. Robert Quayle, superintendent M. P. & M. (C. & N. W. Ry.): Some eight years ago we began using soda ash in the water tanks in Wisconsin, and we got fairly good results from its use. We had a foreman boilermaker on the Wisconsin division of our lines, and he said the care of boilers was everything, and he wanted to demonstrate to the Chicago & North Western Railroad that if we gave him enough money and sufficient time, he would go out into Iowa and get rid of all our troubles. He was a good man, first-class boilermaker, an intelligent man, a man of superior education, and we turned him loose on the Iowa division. The first thing he wanted at the various points was pumps that would give us 150 pounds pressure at the nozzle. We accommodated him and the same old difficulty of cracked sheets continued.

I hope you do not have any idea that those tubes on the table that are heavily coated came from the Iowa division. We often would get coating of $\frac{1}{16}$ of an inch as a maximum on our fire-box sheets, often only a little scale, about $\frac{1}{32}$ of an inch. Yet when we send a new boiler up on to the Wisconsin division, they remain ten, twelve, fifteen years, never a patch on the sheets; they will go out into Iowa and sometimes in ten months they have to have new side sheets; inside of eighteen months or two years they have to have new fire-boxes. We find on various divisions of our road that the conditions are so changed that if we take a man from one division and put him on the other, that while he may not have any trouble at all on one division, even with the same crew and same locomotive, he will have trouble all the time on the other division, the conditions are so changed.

I am not surprised that Mr. Wells, not having had any experience through this country, should think it was simply a question of boiler care. We have on the Iowa division given more attention to our boilers than anywhere else. When we had plenty of power we would let the engine stay in over night; take them in at night, cool them off and wash them out next morning, but we got just the same result as if we had washed them out within an hour, letting cold water come in at the top while the warm water was still running out at the bottom.

We find if we take those engines, as has already been ex-

plained, on the Iowa division, send them up into the northern division, and we will have trouble with them anywhere from two to three weeks, according to the amount of scale that has formed on the flues. After that is gotten out and the flues are expanded, rolled, calked, and made a good job of, then we have no further trouble with them; well, they stay for two or three years. On the Wisconsin division the engines come in for general repairs. We do not touch the flues at all, and we need not touch them for a number of years; let them alone.

Up on the Ashland division near the Lake Superior district we have had the engine running as many as twelve years without having the flues taken out. Through this section of the country we have a great deal of decayed vegetable matter and consequently tannic acid in the water. This accounts for the long life of the flues. I do not believe, however, that it is a good thing to keep flues in a boiler so long. It may be well to do it simply as an experiment, but I believe it to be a good thing to remove the flues every three years or oftener, and make an examination of the inside of the boiler, and examine the sheets, bracing, and flues.

In regard to Mr. Clark, who was the boilermaker who went out into Iowa, he worked there for one year, doing everything he could, working intelligently and earnestly and hard, and then he gave it up. He said, "I cannot do anything out there, the conditions are against me."

Now, we find that conditions there are changing constantly since the introduction of water-purifying plants, and even engines that are running from Sioux City into Council Bluffs, we used to give them a certain quantity of soda ash when they got to Sioux City; we had to discontinue that, because of the the soft water that we are now getting at Council Bluffs; we do not need to put any soda ash in at all, and we had to abandon it altogether on the west end, after we got two of these purifying plants installed and in use on the west end of the Iowa division, so that from the shop standpoint, the roundhouse standpoint, we are already beginning to find good results.

Soda ash, as was suggested by Mr. Manchester, is indeed a splendid thing, and we have used it, as I said, for eight years, and by the use of a pneumatic blow-off cock we have been able to take care of the dissolved scale, the precipitate matter, and throw it off on the right of way, using it a number of times between the division terminals in order to get rid of it before it forms scale, so that we are very much, I might say, in love with the new method that was introduced on the North Western road, and I shall hail with delight the day when we get it all over the Iowa division and through to Chicago, where we are having the most trouble.

I might say up in the two Dakotas and Minnesota we have spent thousands of dollars at one point, putting wells down, some not so deep and some deeper, changing the location of the

tank, but with no better results, and we came to the conclusion a good many years ago that it is not a question of investigation there, but it is a question of getting better results, and after investigation doing the best we can in each case. Many times it is hard to get water at any price; we have had to haul water hundreds of miles to get it at all to run our engines; all the lakes have been dried up in that country for a number of years, and the little rivers that used to be are things of the past. We are glad to say, however, that they are filling up again, and, therefore, we hope to get better results this year.

PROF. WM. F. M. GOSS (Purdue university): Mr. President, I was so interested in Mr. Davidson's paper that when he had concluded I felt that there was little else to be said. The discussion, however, has served to suggest quite a number of things which we can well afford to talk about. Referring to the difference of opinion that has been developed, I would suggest that there can be no question but that any equipment which will supply pure water for use in locomotive boilers, when otherwise bad water would have to be used, may properly be regarded as a tool for maintaining boilers. Accepting this definition, I venture to believe that we shall find no difference of opinion among those who have taken part in the discussion as to the value of such apparatus as Mr. Davidson has described.

I believe that as time goes on, and as our locomotives become more delicate in their mechanism, and the service expected of them becomes more and more exacting, we shall find it profitable to give large attention to this question of boiler water. As Mr. Davidson has remarked, it is only a short time since any attention has been given to it at all. The progress from soda ash in the locomotive tender, to purification stations of various sorts, of which that described by Mr. Davidson may be regarded as a type, has been rapid. This is a beginning; I do not think we can see the end of the process. Mr. Davidson's paper is not the last word; it brings us up to date, but the future of water purification is all before us. When chemical processes have done what they can, there still remain salt waters to be dealt with. These are abundant in certain portions of our country and will, I believe, be treated by distillation. It is now possible by using some form of series apparatus to supply distilled water for ten locomotives by a fuel expenditure equal to that consumed by one. This field, therefore, as well as that which Mr. Davidson has so ably dealt with, is full of promise.

MR. W. B. THROOP (C., B. & Q. R. R.): I would like to inquire if extreme cold weather interferes at all with the operation of this plant and apparatus.

MR. DAVIDSON: It does not, because the smoke stack of our boiler goes up through the second story of our pump house and keeps it warm.

MR. THROOP: This tipper in front there is entirely exposed, as I understand it.

MR. DAVIDSON: Oh, no, it is inside of the building, just as shown by the diagram. It is in the second story of the pump house, the smoke stack from the boiler goes through this second story, and the heat from the stack keeps it warm.

MR. C. T. KINNEY (C. & E. I. R. R.): I have listened to Mr. Davidson's discourse on the question of water treatment this afternoon with much pleasure, and while we have followed it to some extent on the Chicago & Eastern Illinois R. R., we have not made all our tests, nor all our determinations, but we have a little instance that would appear to me to be in line. Where we have hard waters, not using filters to remove the mud or not treating these waters, we find that the use of these hard waters will allow us to have an engine out, say six months before new flues are put in. We found where we had pond or soft waters that our engines were out a year, sometimes thirteen and fourteen months, and the boiler cost for repairs had been less, on the average, taking the soft waters, for a year and over a year, than it had on the engines using hard waters, being out only six months.

Where the question of sulphate of soda or rather alkaline sulphates come in, we have never been troubled to any great extent, only where we had a pond water (the pond being formed by removing ballast we had burned and hole filling with water); at this point we furnished water for engines, but we got a very hard sulphate water, and one we could not use without treatment; here we found the concentration of the alkaline salts became so great that it was practically impossible to use it without great care. We also had the same trouble where we used a mine water, pumping direct from the mine into the tank. This water was also very strongly alkaline and we could not use it without treatment.

I have never tried, at least I have never made the engine tests to find what per cent. of concentration was necessary to cause this priming or foaming.

MR. WILLIAM FORSYTH (*The Railway Age*): Mr. Davidson's remarks relate to scale-making water, and his map of the North Western road ends with the Missouri river. West of that there is a large territory which is troubled with principally alkali waters, and the sulphate of soda which gives trouble by foaming. I wanted to ask Mr. Davidson whether that trouble was of sufficient importance to make it worth while to treat the alkali waters outside of the boiler by the same process that has been shown here?

MR. DAVIDSON: We have alkali waters on our road in Minnesota and Dakota, and we may at some future time treat them. We have not done so yet, because the principal part of our business happens to be elsewhere, and our heavy tonnage and largest number of locomotives are in Iowa, but I have no doubt that it will pay to treat a sulphate water, provided the quantity of it used at any station would warrant its treatment.

I would not advise treating the water where only two or three engines are supplied in a day.

MR. H. G. HETZLER (C., B. & Q. R. R.): I would like to ask Mr. Davidson how much it costs in western Iowa to purify the water by this treatment.

MR. DAVIDSON: I am not at liberty to quote exact figures. Any chemist can take the analyses and approximately figure out the cost, but the cost will vary with every water.

PROF. GOSS: I would like to ask Mr. Davidson if he has counted cost merely as cost of the chemicals?

MR. DAVIDSON: We make up a statement every month showing the cost of operating the water stations. That includes all expenses—wages to the pumper, coal, oil, all supplies, including chemicals, so that we know what it costs us each month at each station. When I said one cent to ten cents per 1,000 gallons, I figured the cost of chemical treatment only; it costs a certain amount to pump water untreated; in addition it costs from one cent to ten cents per 1,000 gallons to soften it with chemicals.

PROF. GOSS: Does that include also interest on the first cost of your plant?

MR. DAVIDSON: Yes.

MR. M. H. WICKHORST (C., B. & Q. R. R.): Mr. Davidson has covered the ground so thoroughly, there is hardly much more to say, and I certainly think we can all congratulate him on the simplicity that he has obtained in this apparatus, and undoubtedly the good results he also obtains. I have figured that it would cost on an average probably, all things considered, along about three cents per 1,000 gallons for treating the water, over and above the cost of obtaining the water anyway. Taking that figure as a basis, the cost of furnishing a heavy freight locomotive with treated water would run up to something like $200 per year per engine. Of course, we do not want to spend that amount of money without getting it back again. The principal saving would come in, probably, from the decreased coal consumption and the decreased repairs. A locomotive will burn up, say $5,000 worth of coal a year, and if there is any coal saving at all, we can figure, say, 3 per cent.; that would be equivalent to about $150 a year saving on the coal.

The boiler repairs probably in a year run, say, $1,200, and there seems to be no question whatever that boiler repair expenses can be considerably reduced, and figuring that we can cut off 25 per cent., that would save about $300 per year per engine. But another material saving would come from the reduced number of washouts. In very bad water districts, engines have to be washed out perhaps in some cases as often as every 400 miles, perhaps every 500 or 600 miles; with good water, such as these plants would furnish, that might be extended to at least 3,000 miles; we could save by reduced washouts anywhere from $50 to $100 a year, say, possibly, $60.

Then another very important source of revenue would be the increased use we get out of the locomotive. A locomotive ordinarily is in the repair shop about 10 per cent. of her time; then she is out of service in addition, due to washing out and repairs in the roundhouse, probably 5 per cent. more, making probably 15 per cent. of the locomotive's time as dead time. By having good water we can save the greater part of the time due to washout, and we can save some of the time due to boiler repairs in the shop, and a large part of or most of it probably, in the roundhouse, so we can save $100 or $200 a year more there, and I figure it as a very conservative estimate that the net saving would probably be $400 per year per engine, and I believe, as Mr. Davidson said in his concluding remarks, that railroads in the very near future will have to consider these water treating plants as a part of the equipment of a water station.

MR. KENNICOTT: I will say in connection with the cost of treatment of waters, that the average of the waters we are now treating with chemicals run a little less than two cents per 1,000 gallons.

MR. E. W. PRATT (C. & N. W. Ry.): I happened to have been fortunate enough to have been in charge of locomotives in the locality using the good water as shown in Mr. Davidson's second analysis and again where the water was nearly as bad as the poorest there shown.

In northern Wisconsin, where we used spring water or Lake Superior water, we had large 20-inch cylinder locomotives and it frequently happened that these engines would be in service a week, and, if working Sundays, two weeks and more without the fire being knocked out of them. To be sure, with the opening of the ore season when we received these engines from Iowa or elsewhere with considerable scale in their boilers, we would have a great deal of trouble with leaky flues and fire-boxes. After the scale around the flues was eaten out and the flues expanded, rolled and calked to the sheet, those engines are frequently under steam and with probably a gradual variation in temperature of the boiler of less than 100 degrees, from one week's end to the other. As a consequence, we kept the arches in those engines all the time.

I do not know whether the majority of the members of the Western Railway club believe in brick arches or not. If they have been boilermakers, of course they do not. Those of us who do not go inside a fire-box very often are apt to believe pretty thoroughly in an arch. Where the flues stay in good condition and do not leak, there is no objection to an arch, even from the boilermaker. I thoroughly believe, then, that the results from good water tend to additional good results from keeping a uniform temperature in our fire-boxes. We caution the fireman, when we are instructing him, to keep the steam pressure uniform; when he is standing on the sidetrack, to be sure and keep up his steam pressure and not allow the fire-box to vary

largely in temperature. We tell a man that if the flues are very weak, to leave some fire—bank his fire in the house—if he is at outlying terminals, and he will keep the flues, and a poor set of them, in service all winter long.

Suppose, on the contrary, we have this boiler-purifying going on inside of the tank and the boiler itself, we know what the results are. At least every three to seven days we must cool that boiler down and wash it out; generally every trip we have got to knock the fire out of the engine; if there is any arch, wait for it to cool down enough to save it, or knock it out, and the boilermaker puts on the blower, goes in there as soon as the steam has gone down from boiler pressure to 10, 20, or 30 pounds. There is a cooling down from nearly 400 degrees to 250 and less in the fire-box) and the expansion and contraction in the flues themselves and the sheets is an additional source of leaky flues. When this engine is fired up the blower is likely used to hurry up and the entire conditions have a downward tendency.

It occurred to me that, as Mr. Davidson was averse to giving his costs in treating the different qualities of water, and inasmuch as he was going into the boiler lagging business with his product, I might suggest that he add these costs to one of the "Boiler Lagging Exhibits A, B, C, or D," that were given to the Western Railway club a year or more ago.

MR. WELLS: I would like to call attention to the confession the gentleman makes about going into the fire-box. I want to say to you, gentlemen, that that is one of the troubles; people do not go into the fire-boxes, no one but the boilermakers. I have found it exceedingly profitable to go into the fire-boxes, and I am not a boilermaker. I hope you gentlemen will consider all that I have said to mean just this: Do not overlook the care of your boiler. That is all.

MR. VAN ALSTINE: I notice on one of the diagrams at one station that they propose to put in a purifying plant, and a little further on, at Bertram, with the incrustiug solids very high, they do not propose to treat it. I assume from that that they do not use much water in Bertram. I would also assume that there is a figure, which is represented perhaps by the product of the number of grains per gallon by the amount of water used at each station, below which they do not consider it profitable to treat the water. Is that true, Mr. Davidson?

MR. DAVIDSON: We use very little water at Bertram. There are several water stations on the Iowa division where we do not expect to install plants because they are unimportant, or because we hope, when we get the more important stations equipped, that we can get along without taking much water at those unimportant stations.

MR. C. B. CONGER (International Correspondence Schools): I would like to ask Mr. Davidson if it would be possible to treat water when it is stored in small ponds at the pumping stations?

We find these storage ponds in the clay country; they are dug in the ground and some of them are 200 or 300 feet long; smaller ones are not over 100 feet square and 20 feet deep. Can the water in these ponds or storage reservoirs be treated before it is pumped up into the elevated tanks that the engines take water from?

MR. DAVIDSON: If we use reservoirs such as the gentleman describes as settling basins, there is no reason at all why they cannot be used. We simply would run the hard water through our mechanical apparatus, mix it with the proper proportion of chemicals, then run it into these reservoirs and let it stand until it settles. We would have practically on a large scale what we now have on a small scale. The same principle would apply to the larger reservoirs as to the smaller tanks.

THE PRESIDENT: Are there any further remarks? If not, we will give Mr. Davidson an opportunity to close the discussion if he desires to do so.

MR. DAVIDSON: I have nothing further to add.

CHICAGO & NORTH WESTERN RAILWAY CO.

CHICAGO, August 25, 1903.

Mr. R. C. Sattley, Supt. B. & B., Chicago, Ill.:

DEAR SIR: Complying with your request asking for information in regard to the cost of operating our water softening plants, I take pleasure in sending you, attached hereto, a carbon copy of my last monthly statement to the assistant general manager, showing in detail the cost of operating these plants.

Very truly yours,

G. M. DAVIDSON.

CHICAGO & NORTH WESTERN RAILWAY CO.

COST OF OPERATING WATER PURIFYING PLANTS FOR MONTH OF JULY, 1903.

STATIONS.	COST OF PUMPING WATER WITHOUT SOFTENING.							COST OF SOFTENING WATER.						
	Gallons of water.	Cost of coal.	Cost of oil waste and supplies.	Cost of repairs.	Wages of pumpers.	Total cost of pumping.	Cost of pumping 1,000 gallons.	Cost of chemicals.	Cost of chemicals per 1,000 gallons.	Increase in wages of pumpers and wages of foreman account of softening.	Cost of increased wages of pumpers and wages of foreman per 1,000 gallons.	Credit for sludge shipped.	Cost of softening per 1,000 gallons.	Total cost pumping and softening per 1,000 gallons.
DeWitt	2,322,619	$34.00	$0.46	$0.25	$90.00	$127.71	$0.0550	$21.76	$0.0094	$15.81	$0.0068	$11.25	$0.0113	$0.0663
Lowden	1,242,612	25.00	2.96	.25	45 00	73 17	0.0589	13.43	0.0108	10.81	0.0087	4.50	0.0158	0.0747
Stanwood	3,332,577	47.50	5.06	.77	90.00	142.33	0.0430	28.98	0.0087	15.81	0.0047	20.50	0.0073	0.0503
Lisbon	823,115	12.50	2.23	.11	45.00	59.84	0.0727	5 99	0.0073	10.81	0.0131	.....	0.0204	0.0931
Beverly	3,505,752	35.00	4.01	.25	90.00	129.26	0.0369	21.22	0.0060	37.58	0.0107	.....	0.0167	0.0536
Belle Plaine	5,110,554	74.00	4.23	.25	90.00	108 48	0.0330	24.15	0.0047	15.81	0.0031	.....	0.0078	0.0408
Tama	3,902,326	61.20	4.50	.27	90.00	156.97	0.0400	31.21	0.0080	15.81	0.0040	.....	0.0120	0.0520
Lamoille	1,377,444	24.00	1.84	.....	88.65	112.49	0.0817	16.04	0.0117	15.32	0.0111	.....	0.0228	0.1045
Ames	3,154,990	45.00	3.58	.....	90.00	138.58	0.0439	29.67	0.0094	15.81	0.0050	.....	0.0144	0 0583
Boone	5,208,380	75.00	2.77	2.98	45.00	125.75	0.0241	55.89	0.0107	10.81	0.0021	.....	0.0128	0.0369
Grand Junction	1,739,660	22.30	3.27	.....	90.09	115.57	0.0664	20.73	0.0119	15.81	0.0091	.....	0.0210	0.0874
Carroll	4,860,285	31.57	.89	.....	45.00	77.46	0.0159	52.74	0.0108	15.81	0.0033	.....	0.0141	0.0300
Westside	543,436	10.00	.13	.....	45.00	55.13	0.1014	15.17	0.0279	19.26	0.0354	.....	0.0633	0.1647
Denison	1,852,012	23.25	2.24	.....	45.00	70.49	0.0381	26.98	0.0145	24.98	0.0135	9.75	0.0228	0.0609
Dunlap	1 857,301	19.35	2.75	3.80	45.00	70.90	0.0382	29.85	0.0161	22.81	0 0123	.....	0.0284	0.0666
Council Bluffs	3,172,591	71.65	.....	4.27	76.94	152.86	0.0482	76.80	0.0242	14.35	0.0045	.....	0.0287	0.0769

G. M. DAVIDSON,
Chemist and Engineer of Tests.

FIG. 53.—Table of cost of operating Water Purifying Plants, C. & N. W. Ry.

Name of Railroad.	Official to whom letter was sent.	Date of letter received and as printed.	Remarks.
	Chief Engineer.		
C., B. & Q. Ry.....	W. L. Breckinridge.	No answer.	
C., M. & St. P. Ry..	D. J. Whittmore.....	Sept. 7, 1903	Report of plant in use.
C., R. I. & P. Ry..	W. L. Darling.....	No answer.	
C., St. P., M. & O..	C. W. Johnson.....	Sept. 7, 1903	Report of plant in use.
C., C., C. & St. L..	G. W. Kittredge.....	Sept. 5, 1903	No plants in use.
C. & A. Ry.....	H. F. Baldwin.....	Sept. 5 and 18	Report of plant in use.
C., G. W. Ry.....	F. R. Coates.....	No answer.	
D., L. & W. R. R..	Lincoln Bush.....	No answer.	
D. & R. G. R. R....	E. J. Yard	Sept. 9, 1903	Report of plants in use.
Erie Railroad.....	W. L. Derr.....	No answer.	
Grand Trunk.....	Joseph Hobson.....	Sept. 8, 1903	No plants in use.
Great Northern..	A. H. Hogeland.....	Sept. 12, 1903	Plants contemplated.
Ill. Cent. R. R.....	H. U. Wallace	Sept. 7, 1903	No plants in use.
L., S. & M. S. Ry..	E. A. Handy.....	Sept. 11, 1903	No plants in use.
Lehigh Valley....	W. G. Berg..... ..	Sept. 15, 1903	Plants being installed.
L. & N. R. R.....	R. Montford.....	No answer.	
Mich. Cent.....	W. S. Kinnear.....	Sept. 8, 1903	Report of plants in use.
M., St. P. & St. M..	Thos. Green.....	Sept. 5, 1903	No plants in use.
M., K. & T. Ry....	S. B. Fisher.....	Sept. 4, 1903	No plants in use.
N. C. & St. L. R. R..	Hunter McDonald..	Sept. 5, 1903	No plants in use.
N. Y. C. & H. R. R. R.	H. Fernstorm.....	Sept. 12, 1903	No plants in use.
N. Y., N. H. & H. R. R	C. M. Ingersoll.....	Sept. 5, 1903	No plants in use.
Norfolk & W. Ry.	C. V. Churchill.....	Sept. 14, 1903	Water filter used.
Northern Pac.....	S. J. Bratager.....	No answer.	
Penn. L. W. of P..	Thomas Rodd.....	Sept. 15, 1903	Report of plants in use.
Penn. Railroad...	W. L. Brown.....	No answer.	
Phila. & Reading.	Wm. Hunter.....	Sept. 11, 1903	No plants in use.
St. L. & San F.....	C. D. Purdon.....	Sept. 4, 1903	No plants in use.
Seaboard A. Line.	W. W. Gwathmey...	Sept. 8, 1903	No plants in use.
So. Pacific.....	Wm. Hood.....	No answer.	
Union Pacific.....	J. B. Berry.....	Sept. 9, 1903	Report of plants in use.
Wabash R. R.....	W. S. Newhall.....	No answer.	
Wis. Central.....	C. N. Kalk.....	Sept. 4, 1903	No plants in use.
Canadian Pac.....	E. H. McHenry.....	Sept. 12, 1903	Plants contemplated.
C. & N. W. Ry....	G. M. Davidson, C. & E. of Tests.	Aug. 25, 1903	Report of plants in use.

Fig. 54.—Roads reporting Water Softening Plants.

UNION PACIFIC RAILROAD COMPANY.

OMAHA, NEB., Sept. 9, 1903.

DEAR SIR:—Yours of September 1st, requesting information for the Association of Bridge and Building Superintendents concerning water softeners, at hand. We have in operation on the Union Pacific Railroad, eleven Kennicott water softeners, varying in size from a capacity of 8,000 gallons per hour to 20,000 gallons, and are erecting twenty-five more softeners at the rate of about three per month.

I enclose herewith a table showing the results obtained at ten of the plants that have been established for some time.

The water is treated by the cheapest of chemicals, common lime being used to precipitate the carbonates of lime and magnesia which are held in solution because of carbonic acid in the water; soda ash is used to react on the sulphates of lime and magnesia, producing the insoluble carbonates of lime and magnesia and the non-incrusting solid sodium sulphate. The water from each station to be treated is analyzed and solutions are prepared of the proper strength for treating these waters. These solutions are introduced automatically into the untreated water in the proper proportion for the volume of water passing through the softener. As time is an important feature in chemical reaction, the water towers are constructed of a size to allow ample time for reaction in passing through the tower. The treated water flows off through a pipe at the top of tower to the regular railway storage plant.

The cost of chemicals for treating waters will vary with the analyses. By referring to the table, you will note that this cost varies from 0.3 to 3.6 cents. In the ten plants we are treating 1,441,000 gallons per day are used at an average cost of 1 1-8 cents per thousand. By referring to the table you will note that the waters containing the larger quantities of sulphates of lime and magnesia are the most expensive to treat. At the same time it is worth more to remove these sulphates of lime and magnesia, as they form the hardest scale and the most difficult to remove from boilers. The additional cost for labor is but little, one man being added to the rolls as an assistant to the chemist, and whose duty it is to keep on the road visiting the various softeners and seeing that they are properly attended to. The preparation of solution is attended to by the regular pumpers at all plants except gravity supplies and where city water is used. At such places some other employé is delegated to attend to this matter, as it does not take more than half an hour daily at the largest plants.

The saving in boiler repairs certainly warrants the expenditure of the amount necessary to treat the waters at all points where we either have or are erecting water softeners. Another saving is in locomotive fuel, which will be no small item, as

the evaporative power of boilers will be increased, or as locomotive firemen express it, "she steams easier."

The value of treating will depend on the quantity of water used daily and the character of such water. While we have been unable to state in exact figures the saving to the company, we are satisfied that at any point where 75 pounds or more of incrusting solids can be removed from the water daily, it is an economy to treat such water.

Referring to the table again, you will note that in the ten plants we are removing 2,790 pounds of solids per day. Cost of chemicals for this work is 58 1-4 cents per hundred pounds of incrusting solids removed. Even though this figure were doubled, it would still be an economy, as any experienced man knows that 100 pounds of scale cannot be removed from boilers for any such figure.

The analyses of water shown on the table were made in the laboratory of the Union Pacific railroad, and show the average results we are obtaining where plants are properly looked after. Weekly analyses are made in order to keep check on the employs and see that they are properly attending to their duties. Besides this check, the traveling assistant to the chemist is liable to visit the plant at any time without giving notice, and as he is provided with a simple outfit for making tests, the character of the work is kept up to a good standard.

Yours truly,

J. B. BERRY,
Chief Engineer.

Mr. R. C. Sattley,
Supt. B. & B., C. & N. W. R. R.,
56 E. Kinzie St., Chicago.

UNION PACIFIC RAILROAD.

Statement Showing Results Obtained in Treating Waters for Boilers, Giving Analyses Before and After Treating, in Grains per Thousand Gallons, and Pounds Incrusting Solids Removed Daily at Each Plant.

	Council Bluffs, Ia.		Valley, Neb.		Columbus, Neb.		Grand Island, Neb.		Kearney, Neb.		No. Platte, Neb.		Julesburg, Col.		Sidney, Neb.		Cheyenne, Wy.		Point of Rocks, Wy.	
	Before.	After.	Before.	After.	Before.	After.	Before.	After.	Before.	After.	Before.	After.	Before.	After.	Before.	After.	Before.	After.	Before.	After.
Silica	1.97	1.57	1.73	1.81	2.54	1.84	1.49	1.52	2.42	2.00	2.86	2.01	2.83	2.27	3.17	2.92	2.42	2.19	1.92	.63
Oxides of iron and aluminum	2.33	.36	.13	.06	.44	.47	.44	.21	.20	.15	.26	.26	.11	.35	.44	.12	.14	.15	.39	.20
Calcium carbonate	14.19	1.48	6.52	1.93	14.22	1.20	5.42	2.50	10.01	1.33	7.94	1.98	7.40	1.28	6.68	1.45	9.29	1.31	8.19	2.55
Calcium sulphate	8.32	.....	1.19	.....	1.67	.....	1.86	.....	1.10	.....	4.53	.....	2.10	.....	2.14	.....	.....	.....	.....	.....
Magnesium carbonate	.84	1.50	1.46	.54	2.94	1.43	.79	.54	2.24	1.26	1.35	1.08	3.56	.96	2.16	.44	2.34	.91	4.08	.88
Magnesium sulphate	10.35	.....	.95	.....	2.81	.....	1.41	.....	.38	.....	2.43	.....	1.74	.....	.44	.....	.....	.....	3.47	.....
Total incrusting solids	38.00	4.91	11.98	4.34	24.62	4.94	11.41	4.77	16.35	4.74	19.37	5.33	17.74	4.86	15.03	4.93	14.19	4.56	18.05	4.26
Non-incrusting solids	9.00	29.37	3.74	5.38	6.12	15.61	2.10	7.88	5.33	10.28	9.12	19.89	7.52	13.93	1.78	10.47	2.46	3.91	23.74	27.26
Total solids	47.00	34.28	15.72	9.72	30.74	20.55	13.51	12.65	21.68	15.02	28.49	25.22	25.26	18.79	16.81	15.40	16.65	8 47	41.79	31.52
Cost of chemicals per 1,000 gallons	3.6 cents.		0.4 cents.		1.3 cents.		0.9 cents.		1.1 cents.		1.2 cents.		1.3 cents.		0.9 cents.		0.3 cents.		1.0 cents.	
Gallons water treated per day	130,000		89,000		140,000		180,000		56,000		170,000		122,000		140,000		270,000		144,000	
Pounds incrusting solids removed per day	615 lbs.		96 lbs.		393 lbs.		171 lbs		93 lbs.		340 lbs.		224 lbs.		202 lbs.		372 lbs.		284 lbs.	

Chief Engineer's Office, Omaha, Sept. 8, 1903.

FIG. 55.—Table showing results of water tests, Union Pacific Ry.

NORFOLK AND WESTERN RAILWAY CO.

ROANOKE, VA., Sept. 14, 1903.

Mr. R. C. Sattley, Supt. B. & B., 56 East Kinzie St., Chicago, Ill.

DEAR SIR: In answer to your letter of September 1st I enclose you copy of letter from our Mr. H. T. Herr, master mechanic, showing our method of purifying water chemically as far as we practice it. I also send you print of general plan Y-3887 showing form of construction of filter culverts, two of which we have in use on the road, and another one is being arranged for. This particular one is used at one of our small yards where the water, which is taken from James river, is quite muddy, but after it passes through this filter culvert it is made entirely free from mud. To explain the construction of the culvert I should add that the covering stone and the first course of stone underneath are laid in cement, but the stones underneath this down to solid rock are laid dry. This allows the water to pass into the filter culvert just as fast as it is pumped out and no faster. In this way it is forced to pass through a bed of gravel which removes mud from the water. We have had one of these plants in use since 1888 in a very muddy stream, made muddy by ore washings, and the river at times is thick with this mud from iron ore washings, nevertheless the water that comes into our tanks is as clear as water can be. Of course there are many ways of constructing filters on this principle, but I make note of this because it is one of the simplest forms I know of.

Yours truly,
CHARLES S. CHURCHILL,
Chief Engineer.

ROANOKE, VA., Sept. 11, 1903.

Mr. W. H. Lewis, Supt. Motive Power.

DEAR SIR: Referring to attached papers relative to the manner of purifying water in our locomotive boilers, would advise, that as a general proposition the water on our territory is good, but some of it, particularly on the east end of the Norfolk division and the Radford division, we are treating with soda ash, using ½ lb. per 1,000 gals. at a cost of 95c. per 100 lbs.

We have no water purifying plants where we purify the water before it enters the boilers, but simply treat our water in the engine tank by putting in a specific amount of soda ash, the amount of soda ash being dependent on the locality as determined by our chemist's analysis of the various waters used.

Yours truly,
H. T. HERR,
M. M.

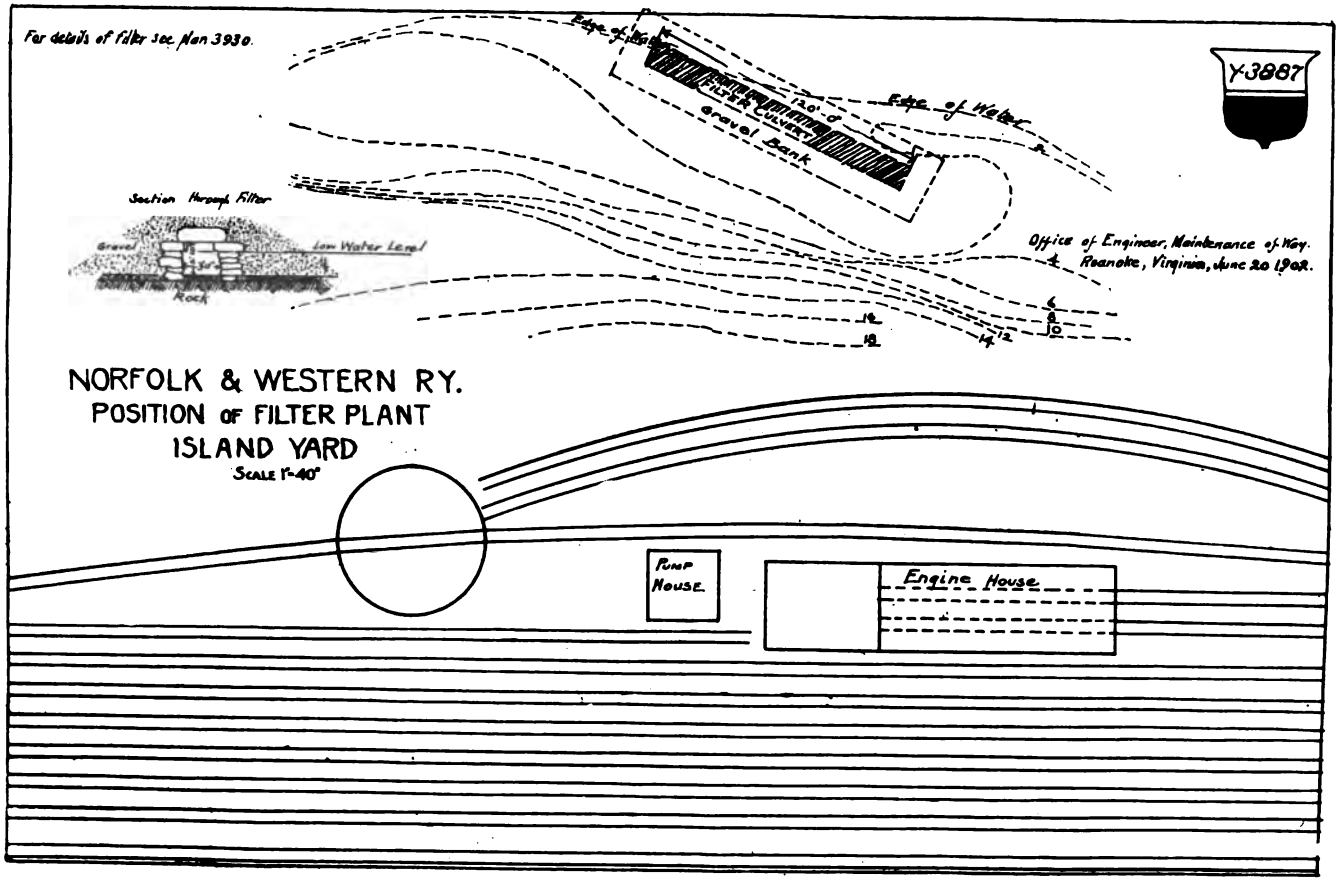


FIG. 56.—Filter Plant, Norfolk & Western Ry.

DENVER & RIO GRANDE RAILROAD SYSTEM.

DENVER, COL., Sept. 9, 1903.

Mr. R. C. Sattley, Supt. B. & B., Chicago & North Western Ry. Co., No. 56 East Kinzie St., Chicago, Ill.

DEAR SIR: Replying to your circular letter of the 1st inst. requesting certain information concerning water filters and other methods of purifying water for engine use:

We have three purifying plants in use on this system, two put in by the Industrial company, one at Ruby and one at Helper, and one put in by the Tweeddale company at Thompson's Springs.

The estimated cost of chemicals per thousand gallons at Ruby and Helper is approximately 1 cent, though the cost for operating the plant, that is, including labor and chemicals, averages about 4 cents. The cost of the chemicals per thousand gallons of water treated at Thompson's by the Tweeddale system is 7.6 cents; labor, fuel, and incidentals bring up the total cost of treatment to 11¼ cents.

Our first purifying plants were installed in the fall of 1900, but as we have a great deal of bad water on the division on which they are located, we have not yet secured any reliable data showing the amount saved in cost of repairs per locomotive per year, by using purified water. I am enclosing with this a statement showing cost of operating Tweeddale plant at Thompson's for the month of June. Owing to the steam shovel operations in that vicinity during the period covered by the statement, it was found that the water did not have time to settle and clarify by gravity, and it became necessary to use the sulphate of alumina as a coagulent, which largely increases the cost of operating the plant.

We have just received analyses and reports on thirteen water stations on the system, where we are looking into the advisability of treating the water. These waters average 42.48 grains of solids per U. S. gallon, and the average estimated cost of chemicals to treat same is about 1¾c. per thousand gallons. Our experence, as you will note from the above, shows that the cost of the chemicals after all is but a small portion of the cost to treat, and I believe it is safe to say that it will cost from 4½ to 5 cents per thousand gallons to treat these waters.

I believe I have covered all the information requested so far as possible at present. However, if you feel that I can be of any further assistance to you, I will be glad to accommodate you in the matter.

Yours truly,

E. J. YARD,
Chief Engineer.

Cost of treating water at Tweeddale plant, Thompson's Springs, month of June, 1903:

Labor		$55.00
Materials:		
210 bu. lime at 28c.	$58.80	
1,625 lbs. sulphate alumina at 3¾c.	60.94	
7 tons slack coal at $1	7.00	
1 gal. valve oil	.52	
		$127.26
		$182.26

Number of gallons water treated, 1,575,000.
Cost per thousand gallons, $0.115.

PENNSYLVANIA LINES WEST OF PITTSBURGH.

PITTSBURGH, PA., Sept. 15, 1903.

Mr. R. C. Sattley, Supt. B. & B., C. & N. W. Ry., Chicago, Ill.

DEAR SIR: Referring to your letter of the 1st inst. requesting information concerning water purifying plants. I enclose to you herewith a letter from Mr. D. F. Crawford, our general superintendent motive power, which I trust will answer all your questions fully.

Yours truly,
THOS. RODD,
Chief Engineer.

PITTSBURGH, Pa., September 14, 1903.

Mr. Thomas Rodd, Chief Engineer.

We have recently installed two water purifying plants on the Northwest System; one at Washington, Ohio, and the other at Middlepoint, Ohio, each having a capacity of 10,000 gallons per hour. These plants were put up by the Industrial Water Co., of New York, on what is known as the "Automat System"; *i. e.*, the system in which the incoming raw water actuates the wheel which drives the stirring mechanism. The chemicals used for purification are lime and soda ash. The plants cost $6,800 each, and have been in service since June.

During the month of August the cost of treating the water at Washington, including interest and deprociation charge of 10 per cent., was:

Total cost per 1,000 gallons treated, $ .02238.
Average scale-forming material in raw water, 29.04.
Average degree of hardness of treated water, 4.97.

At Middlepoint:

Total cost per 1,000 gallons treated, $ .06052.
Average scale-forming material in raw water, 54.17.
Average degree of hardness of treated water, 5.98.

As these plants were only put in operation in June, 1903, we are unable to give any data regarding the saving in boiler repairs.

D. F. CRAWFORD,
General Superintendent Motive Power.

THE CHICAGO & ALTON RAILWAY COMPANY.

SLATER, MO., September 5, 1903.

Mr. R. C. Sattley, Superintendent Bridges and Buildings, Chicago & North Western Railway, Chicago, Ill.

DEAR SIR: Replying to your favor of September 1, requesting information on water filters, and other methods of purifying water for engine use, I beg to state that on this division of the Chicago & Alton Railway we do not use any system of filtration or water purification prior to the water being put into the boilers. Although we use pond water, it is heavily charged with solids. I have, since I have been here, as yet not seen a chemical analysis of this water so that I cannot inform you the exact amount of solids in the water. I would state, however, that in one of our stationary boilers, it left a deposit on the tubes of $\frac{3}{16}$ of an inch in six months, and that I have removed incrustations from the crown bolts after road engines had been in service 13 months, $\frac{1}{16}$ of an inch thick.

We have in the last few months adopted in some of our engines what is known as the Talmage system of boiler washing. The offices of this company I believe are located at Cleveland, Ohio. While I have no desire to boom any one particular thing, I must in all justice to the Talmage people state that I have never seen any system of water purification that impresses me as favorably as this. It consists of a series of blow-off cocks and pipes, placed in various parts of the boiler, and also of a lubricator placed upon the back boiler head which feeds an oil manufactured by this company directly into the boiler. The engines that are fitted with this device make 8,000 miles between washouts. We have had no trouble whatever from these engines foaming or leaking. After they have made 8,000 miles, a removal of the washout plugs will simply show a deposit of soft mud on the mud ring from 3 inches to 4 inches deep; the iron, that is, the fire-box sheets, flues, etc., show absolutely no scale, being as clean as the day they were applied.

I have no figures at hand showing the cost of this device, but can state that we save enough in labor for boiler washing to pay for the oil used, and then we can turn an engine immediately

upon arrival at any time, as it is never necessary to hold for boiler washing. With this device we simply blow the engine out on their arrival, and if they have stood in the round-house any length of time, blow them out again prior to departure.

I trust this information may be of some value to you.

Yours truly,

T. P. ROESCH,
Master Mechanic.

THE CHICAGO & ALTON RAILWAY COMPANY.

CHICAGO, September 18, 1903.

Mr. R. C. Sattley, Superintendent Bridges and Buildings, Chicago & North Western Railway Co., 56 East Kinzie Street, Chicago, Ill.

DEAR SIR: Replying to your circular letter of September 1, with reference to water purifying, beg to advise that we have only one water purifying plant in operation on our line, which is at Bloomington, Illinois. This is a Wefugo plant furnished by Scaife Brothers. The estimated cost per thousand gallons for purifying water is about six cents. Referring to your other question regarding the amount saved in cost of repairs to locomotives by using this purified water, our superintendent of motive power advises that he has no statement of this, but in his opinion the saving would be very small.

Yours truly,

H. F. BALDWIN,
Chief Engineer.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.

CHICAGO, September 7, 1903.

Mr. R. C. Sattley, Supt. B. & B., C. & N. W. Ry., Chicago.

DEAR SIR: Replying to your letter of September 1st, addressed to Mr. D. J. Whittemore, and which has been referred to me for reply.

I cannot answer your questions fully for the reason that I have not the data at hand, but will say, however, that Mr. A. E. Manchester, our superintendent of motive power at W. Milwaukee, can probably give you the information desired, as the water purifying plants are in the hands of the motive power department.

Will say, however, that we have now in operation at Coburg, Mo., a water filtering plant put in by the Jewell Filter Co., of Chicago, which has been in operation for some two years, and I understand is working quite satisfactorily.

We have just completed the installation of a water purifying plant at Elk Point, S. D., using the Kennicott system, but it

has not been in use long enough to ascertain results. The first named plant is intended solely for the clarifying of muddy water, the latter is for the purification of well water impregnated with lime and other incrusting solids.

I regret to be unable to give you all the information desired. I am certain, however, that Mr. Manchester, our superintendent of motive power, can give you further information regarding the matter.

Yours truly,

C. F. LOWETH.

MICHIGAN CENTRAL RAILROAD CO.

DETROIT, MICH., September 8, 1903.

R. C. Sattley, Supt. B. & B., C. & N. W. Ry. Co., Chicago, Ill.

DEAR SIR: Your letter of September 1st, in relation to water filters, was referred to our superintendent of buildings, who has such matters in charge.

Please note his notations in pencil on your letter, next attached.

The scarcity of information is due to the fact that these filters have been but recently installed.

Yours truly,

W. S. KINNEAR.

CHICAGO & NORTH WESTERN RAILWAY CO.

CHICAGO, ILL., September 1, 1903.

Mr. W. S. Kinnear, Chief Engineer, Michigan Central R. R., Detroit, Mich.

DEAR SIR: As chairman of committee on "Water filters or other methods of purifying water for engine use" for the Association of Railway Superintendents of Bridges and Buildings, I am after information to compile a report for the annual convention, to be held at Quebec, October 21 and 22, 1903.

If consistent for you to answer any of the following questions, I would be greatly obliged for the information:

Have you water purifying plants in operation on your road? Yes.

If so, what system? The New York Continental Jewell Filter.

What is the estimated cost per thousand gallons for purifying water? No data.

Do you consider the saving in the expense of repairing boilers warrants the cost of purifying the water before it is put in the boilers? Yes.

Have you had water purifying plants in operation long enough so you can give amount saved in cost of repairs per

locomotive per year by using purified water? If so, please state the amount. Could not say.

Can you send me a statement showing the operation of any of your plants? No.

A reply with answer to all or any of the above questions will be greatly appreciated, and *I will reciprocate* by sending you a copy of report made by our committee at the convention.

On account of the short time that I have in which to make up my report I would be pleased to have your reply not later than September 19th.

Hoping that I may receive the information from you as requested, I am, Very truly yours,

R. C. SATTLEY,
Supt. B. & B.

56 East Kinzie street, Chicago, Ill.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RAILWAY CO.

ST. PAUL, MINN., September 7, 1903.

Mr. R. C. Sattley, Supt. B. & B., C. & N. W. Ry., 56 E. Kinzie St., Chicago, Ill.

DEAR SIR: Replying to yours of the first instant with reference to purifying water. I enclose herewith a letter from our mechanical engineer, which I think answers all the questions asked in your letter to me.

Yours truly,

CHAS. W. JOHNSON,
Chief Engineer.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RAILWAY CO.

ST. PAUL, MINN., September 5, 1903.

Mr. H. P. Padley, Assistant Engineer, St. Paul, Minn.

DEAR SIR: Answering your telephone inquiry concerning water purifying plants, information desired by the convention of superintendents of bridges and buildings, questions and answers are given below:

Q. Have you purifying plants on your road?
A. Yes, five.
Q. If so, what system?
A. Four of the Helwig Mfg. Co., one Kennicott, and one under contemplation of the Davidson type.
Q. What is the cost per 1,000 gallons?
A. For chemicals, three cents (3c.) Labor varies according to amount purified.

Q. Do you consider the saving in expense of repairing boilers warrants the purifying of the water before it is put into the boilers?

A. Yes.

Q. Have you had plants in operation long enough so you can give amount saved in cost of repairs per locomotive per year by using purified water? If so please state.

A. Have not.

Q. Can you send me statement showing operation of your plants?

A. Have none.

Yours truly,

B. R. MOORE,
Mechanical Engineer.

LEHIGH VALLEY RAILROAD CO.

NEW YORK, September 15, 1903.

Mr. R. C. Sattley, Supt. Bridges and Buildings, C. & N. W. Ry., Chicago, Ill.

DEAR SIR: Aswering your circular inquiry relative to "Water filters or other methods of purifying water for engine use," we have recently arranged for several purifying plants to be installed on our Buffalo division, one of which has just been placed in use, so that I cannot give you any information relating to the operation of these plants.

The system used is that of the Pittsburgh Filter company, with 300,000 and 100,000 gallons daily capacities. The estimated cost per 1,000 gallons of purifying water is 1½ to 2c.

Where the water is bad for boiler purposes it is certainly desirable to purify same.

Yours respectfully,

WALTER G. BERG.

CANADIAN PACIFIC RAILWAY COMPANY.

MONTREAL, September 12, 1903.

Mr. R. C. Sattley, Supt. B. & B., C. & N. W. Ry., Chicago, Ill.

DEAR SIR: Replying to your circular letter of September 1st. The Canadian Pacific has no water purification plants in operation upon its lines, but has the matter under consideration with a view to making a number of such installations. It is expected to use the familiar Clark-Porter process with lime and soda ash. The cost of the treatment necessarily varies with the character and amount of the salts in solution but there can be no doubt that the expense of repairing boilers warrants the cost of purifying water. Yours truly,

E. H. MCHENRY,
Chief Engineer.

GREAT NORTHERN RAILWAY LINE.

ST. PAUL, MINN., Sept. 12, 1903.

Mr. R. C. Sattley, Superintendent Bridges and Buildings, C. & N. W. Ry., 56 E. Kinzie St., Chicago.

DEAR SIR: Replying to your favor of the 1st inst., relative to the purification of water supply on this system, I beg to say that we have no water-purifying plant in service nor have we as yet installed any. I am therefore unable to give you any information as to the cost, or what the saving might be in the repairs of locomotive boilers during the year. However, we have lately had the matter up with Messrs. W. B. Scaife & Sons Co., who have an office in the Manhattan building, Chicago. This firm seems to have gone pretty thoroughly into the matter of water softening and purification, and I think could probably give you considerable information on the subject. We have gone to a good deal of expense within the last few years on the Montana division where we had the most trouble with impure water, digging settling basins and reservoirs and pumping into these and allowing the water to settle before pumping into the tank, and in consequence have found that we are getting a much better quality of water.

For the most part we use gasoline engines in connection with our pumping plants and are substituting them as quickly as possible for the old steam pumps; and I would say that our water costs us on an average about 3½ cents per thousand gallons.

Yours truly,

A. H. HOGELAND,
Chief Engineer.

In conclusion of this subject it is the opinion of your chairman that purification of water for locomotive use is no longer an experiment. The exact saving in cost of repairs to locomotive boilers is still undetermined as plants on American railroads have not been in use long enough for statistics of this nature to have been compiled. European railroads have been purifying water for locomotive use for many years and the fact that more water-purifying plants are being installed each year on European railroads is proof of the benefit derived from purifying water for locomotive use.

R. C. SATTLEY,
Chairman of Committee.

SEABOARD AIR LINE RAILWAY.

PORTSMOUTH, VA., Sept. 25, 1903.

Mr. R. C. Sattley, Supt. B. and B., C. & N. W. Railway Co., 56 E. Kinzie St., Chicago, Ill.:

DEAR SIR: Your letter of Sept. 1st to our chief engineer, Mr. Gwathmen, has been referred to me for attention and direct reply.

Owing to my absence from the city on vacation, I was unable to make reply within the time requested. I, however, beg to state that we have nothing in the way of water-providing plant or filters on our system.

Yours truly,

R. P. SANDERSON,
S. M. P.

SOUTHERN PACIFIC COMPANY.

SACRAMENTO, CAL., Sept. 22, 1903.

Mr. R. B. Sattley, Supt. B. and B., C. & N. W. Ry.:

DEAR SIR: Your letter of Sept. 1st, to Mr. Wm. Hood, has been referred to me, Sept. 14th. I regret lateness of reply, as follows:

We have in operation nine plants with the Stillman apparatus.

The estimated cost for treatment per 1,000 gallons varies from 1½ cents to 6 cents, depending on quality of the water.

We consider the saving in cost of boiler repairs at 50 per cent. by use of treated water. Can give no cost per locomotive, as our power varies so in location. Locomotives run from treated to untreated waters, as service demands.

Herewith blue print, showing the apparatus.

Yours truly,

H. STILLMAN,
Engineer of Tests.

CHICAGO, BURLINGTON & QUINCY RAILROAD.

CHICAGO, Sept. 24, 1903.

Mr. R. C. Satterly, Supt. B. and B., C. & N. W. Ry., Chicago:

DEAR SIR: Replying to yours of the 1st, inquiring about the Kennicott water-softening plants.

We have three in operation, but as they are all in an experimental stage, I am unable to give you any information at this time regarding the results obtained by their use.

Yours truly,

W. L. BRECKINRIDGE.
Chief Engineer.

THE CHICAGO, ROCK ISLAND & PACIFIC RAILWAY CO.

CHICAGO, Oct. 12, 1903.

Mr. R. C. Sattley, Supt. B. and B., C. & N. W. Ry., Chicago:

DEAR SIR: Referring to your letter of some time ago in regard to results obtained by this company in the use of water-treating plants.

This company has let a contract recently for the erection of fifteen of these plants, but they are not yet in operation, and I can therefore give you no information in regard to them.

Yours truly,

W. L. DARLING,
Chief Engineer.

THE WABASH RAILROAD COMPANY.

ST. LOUIS, MO., Oct. 5, 1903.

Mr. R. C. Sattley, No. 56 East Kinzie St., Chicago, Ill.:

DEAR SIR: Replying to your circular letter of Sept. 1st. I enclose herewith copy of reply which I received from Mr. J. B. Barnes, Supt. M. P. and M. on the Wabash Railroad, concerning "Water filters or other methods of purifying water for engine use," which, I think, will give you the desired information.

Yours truly,

W. S. NEWHALL,
Chief Engineer.

THE WABASH RAILROAD COMPANY.

SPRINGFIELD, ILL., Oct. 3, 1903.

Mr. W. S. Newhall, Chief Engineer, St. Louis, Mo.:

DEAR SIR: Replying to yours of Sept. 10th, and returning letter from Mr. R. C. Sattley, Supt. B. and B., C. & N. W. Ry., Chicago, we would say we have a purifying plant at Peru known as the Kennicott system. This plant was put in two years ago, but owing to a mixture of waters at that place we have never received entire satisfaction from its operation. This, however, is perhaps no fault of the machine or methods employed. The cost for purifying will not exceed 2¼ cents per 1,000 U. S. gallons, with price for reagents per 100 pounds, lime 50 cents, soda ash (48° test) at $1.00.

The maximum softening capacity of our plant is 8,000 gallons of water per hour.

Character of water:

Peru City Wells.

	Untreated.	Treated.
Silicia,	0.3499	0.1750
Calcium sulphate,	4.4322	trace
Calcium carbonate,	12.5384	0.9331
Magnesium carbonate,	7.4647	3.4407
Sodium carbonate,	2.4793	1.8662
Sodium sulphate,	.....	4.7821
Sodium chloride,	14.2579	13.2965
Total,	41.5224	24.4936

The above analysis was made March, 1902. The water is a good water, with the exception of the presence of chloride of sodium (salt). The purifier will not eliminate the latter element,—nothing but distillation will.

Can give you nothing definite enough for statement relative to comparison of cost of repairs before and after using the purifier.

I would add that the loosening of incrusting elements by the employment of reagents, ofttimes causes considerable trouble on account of foaming, also, where reagents are employed, engines must necessarily be washed and blown out oftener, otherwise you possibly may have trouble on account of loosening sediment baking or rehardening upon crown sheets and flues. We will possibly experiment further with our purifier with our present water supply, which has been recently opened up for permanent use.

Yours truly,

J. B. Barnes.

X.—Best Method of Storing Fuel Oil, with Appliances for Supplying Locomotives and Including Plan of Water Stations, Showing Relative Arrangements of Fuel and Water Supply.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Gentlemen:—Your committee have not been able to gather much variety of information on the above subject, owing to the fact that but few railroads use oil as fuel for their locomotives. They are indebted for plans, etc., furnished, to Mr. John D. Isaacs, assistant engineer maintainance of way, and Mr. F. W. Mahl, mechanical engineer of the Southern Pacific Company; Mr. C. R. Morrill, resident engineer of the Southern Pacific Company's lines in Louisiana, at Algiers; Mr. C. A. Morse, acting chief engineer of the Atchison, Topeka & Santa Fe Railway Co., and Mr. W. H. De France, train master of the Kansas City Southern; and for photographs to Mr. W. Kennedy, geologist of the Southern Pacific Co., Atlantic System.

In planning a fuel oil station there should be provided a track on which to receive the tank cars in which the supply of oil is brought; a storage tank of sufficient capacity; a delivery tank and stand pipes for supplying the locomotives, and a pump or other means for transferring the oil from the cars to the storage and delivery tanks.

In unloading oil from the cars there are three methods in use:

1. By simply opening the valves under the cars and letting the oil run into a trough located between the rails, from which the oil flows into a vat or sump and from it again it is pumped into the storage and delivery tanks.

2. By the use of compressed air to unload direct from the cars into the tanks.

3. By connecting the tank cars to a line of pipe alongside of the track which, in turn, is connected direct to the pump and storage tanks so that the oil is pumped by steam direct into the tanks. Where this plan is followed one boiler can serve both the water and oil pumps and one man can attend to both pumps.

Storage tanks run from 5,000 to 55,000 barrels capacity, according to the necessities of the case. In locating them at or near a town, it must be borne in mind that, owing to the inflammable nature of the oil, opposition is apt to be met with from the authorities. When the location is finally decided upon the ground should be brought to a level and the tank laid on the earth without any further foundation, provided, of course, that the ground is of such a character that it will support the weight without settling more than a few inches. Sometimes the ground

is first saturated with oil before erecting the tank; we cannot say, however, if there is any merit in the practice. The tank or tanks should be surrounded with an embankment, high enough and far enough away so that the space enclosed will be more than sufficient to hold all of the oil stored in the tanks when full, in order to guard against the failure of the tank or the oil taking fire. In building the surrounding embankment the earth should not be taken from the inside unless the borrow pits can be thoroughly drained. If water stands in the borrow pits, more or less waste oil floats on top of it and is in constant danger of taking fire. Attached hereto are copies of specifications under which a large number of the storage tanks of the Southern Pacific were built.

Delivery Tanks.—Where it is permissible to elevate the tank above the rails, an ordinary water tank elevated high enough to give the proper head will answer all purposes. It should also be surrounded by an embankment for safety's sake. Where it is not possible to elevate, we recommend the Southern Pacific Company's delivery tank plan, which is partly buried to satisfy both municipal ordinances and insurance regulations.

The use of compressed air for handling oil entails no great extra expense at shops and terminals where plants have already been installed for testing cars and driving shop tools. You will note that in the plan of the delivery tank of the A., T. & S. F. Railway Co. provision for heating the oil in cold weather is made by a steam coil inside the tank near the discharge valve.

The stand pipes shown herewith follow the same general design, and speak for themselves. Owing to the explosive character of the gas given off by fuel oil firemen and other employees are forbidden to go near the opening in the tender tank with lights of any kind. To guard against carelessness on their part a head light should be mounted on a post alongside the track at each point where locomotives are supplied, and so arranged that it can be trained from below by ropes on the manhole in the tender tank.

When the water and fuel oil stations are at the same point, either a double or two separate oil stand pipes should be erected with a spout on either side of the water spout or *vice versa*, so that water and oil can be delivered with only one stop of the locomotive.

Photographs 1, 2, 3, and 4 are views at Lafayette, La., where the Southern Pacific Company has a sixteen-stall roundhouse and two storage tanks.

No. 1 is a view of the 55,000 barrel storage tanks and wooden elevated tank within the same embankment enclosure.

No. 2 shows a standard oil stand pipe. The crane shown back of the tender of the locomotive is one of the first erected for handling oil.

No. 3 is another view of the storage tank showing also the pump house and embankment. The embankment in front of the

pump house is one separating the space enclosed around No. 1 from that around No. 2.

No. 4 shows "battle ships" or oil tank cars being unloaded by direct connection with the pump and tanks.

No. 5 represents oil and water station at Berwick, La. Many of the members will recognize the water tank to the left of the picture.

No. 6 represents the interior of the pump house at Berwick; water pumps to the left and oil pumps to the right, boiler in the middle, serving both.

No. 7 is a view showing the whole station at Berwick, La.

No. 8 is a view of a 55,000 barrel storage tank at Cleburne, Texas, on the Santa Fe system.

Your committee have no recommendations to make, the plans collected covering different conditions. It is presumed each is the best of its kind.

The following two letters, one from Mr. John D. Isaacs, assistant engineer maintainance of way, San Francisco, and from Mr. C. A. Morse, acting chief engineer of the Atchison, Topeka & Santa Fe, at Topeka, Kan., will be of interest to the members.

Your attention is invited to the several plans of the Santa Fe route of the Southern Pacific, and the K. C. S., accompanying this report.

Respectfully submitted,

C. C. MALLARD,
Chairman.

FIG. 57.—Fifty-five thousand bbl. Storage Tank and 620 bbl. Delivery Tank, Lafayette, La

FIG. 58.—Oil Stand Pipe at Lafayette, La.

FIG. 59.—Storage Tank, Pump House, and unloading Tank Cars, Lafayette, La.

FIG. 60.—Oil and Water Station at Berwick, La.

FIG. 61.—Station at Berwick, La.

FIG. 62.—Fifty-five thousand bbl. Storage Tank, Cleburn, Tex.

SPECIFICATIONS FOR STORAGE TANK FOR OIL FOR SOUTHERN PACIFIC COMPANY.

Capacity, 30,000 barrels.

Dimensions; 84 feet and 6 inches diameter by 30 feet in height.

Foundations: All foundations to be graded and completed by railroad company.

Material: Tank steel, American Steel Manufacturers' Association standard specification.

All material, as to quality and dimensions, subject to inspection and acceptance at the mill where the materials are made before any constructional work is commenced; all cost of inspection to be paid by first party.

Thickness of material:

Bottom plates, sketch No. 4 gauge; diameter of rivets ⅞ inch.

Bottom plates, rectangular 3-16 gauge; diameter of rivets, ⅞ inch.

Bottom angles, 4x4x½ inches gauge; diameter of rivets, 11-16 inch.

First ring, 16-lb. square feet; diameter of rivets, 11-16; cross seams double riveted.

Second ring, 14-lb. square feet; diameter of rivets, 11-16; cross seams double riveted.

Third ring, 12-lb. square feet; diameter of rivets, ⅝; cross seams double riveted.

Fourth ring, 10-lb. square feet; diameter of rivets, ⅝; cross seams single riveted.

Fifth ring, 9-lb. square feet; diameter of rivets 7-16; cross seams single riveted.

Sixth ring, 7½-lb. square feet; diameter of rivets, 7-16; cross seams single riveted.

Top angles, 2½x3½x5-16 inches, or ⅝ inches; diameter of rivets, 7-16.

Steel sheeting, No. 20 gauge, laid on tar paper, and nailed with 3-penny nails.

Roofing: Roofing to be built of 6x6 inches posts, 5x12 inches beams, 2x8 inches rafters and sills, 1x8 inches or 12 inches wood sheeting, 1x6 inches braces.

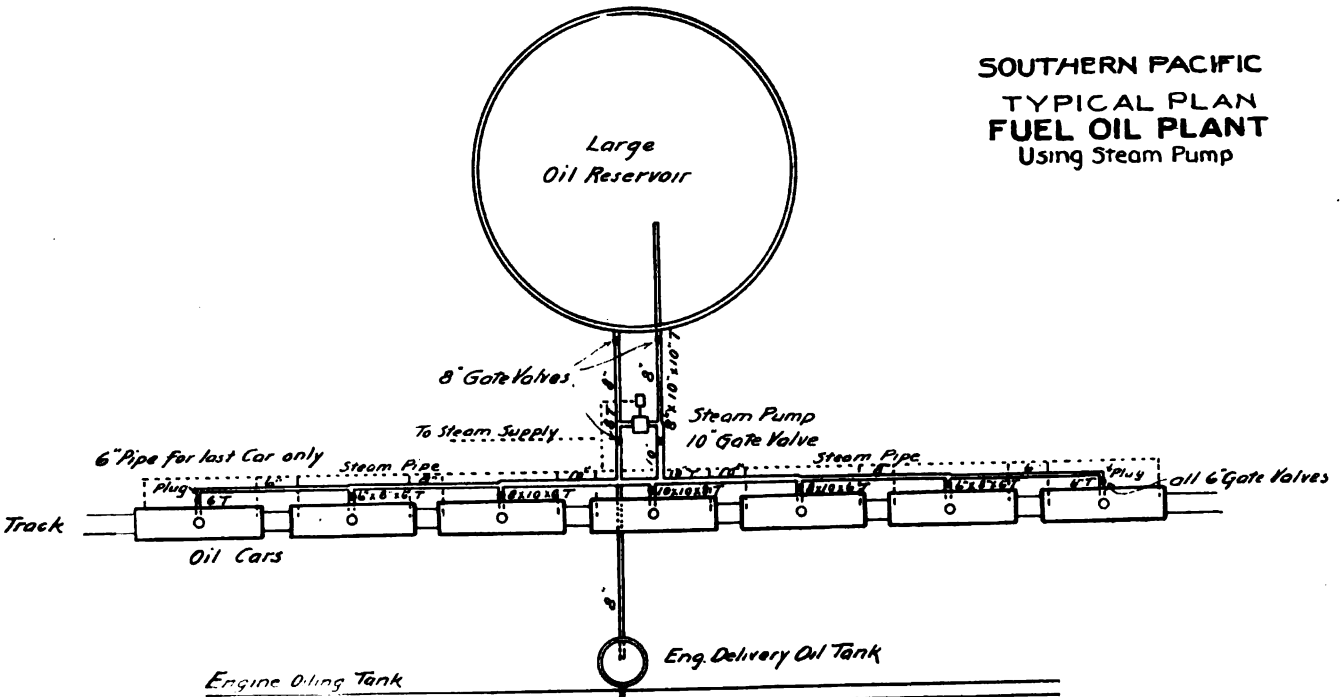


FIG. 68.—Fuel Oil Plant, Southern Pacific Co

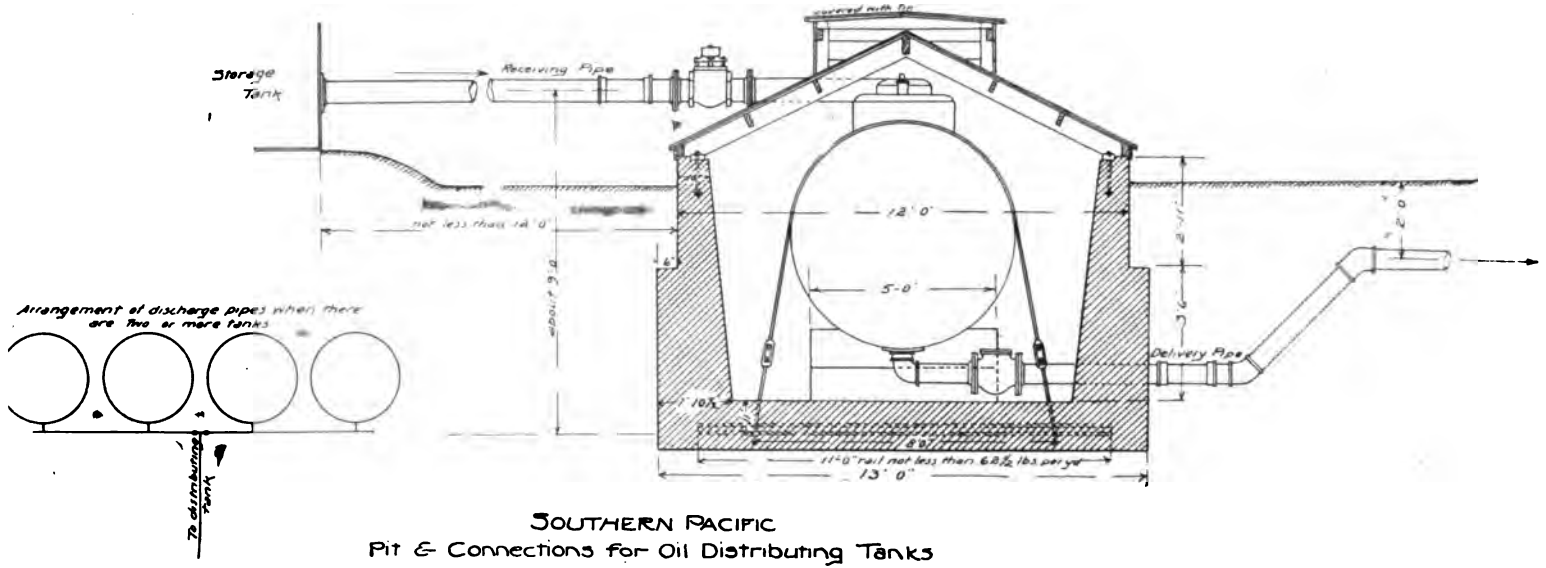


FIG. 64.—Oil Distributing Plant, Southern Pacific Co.

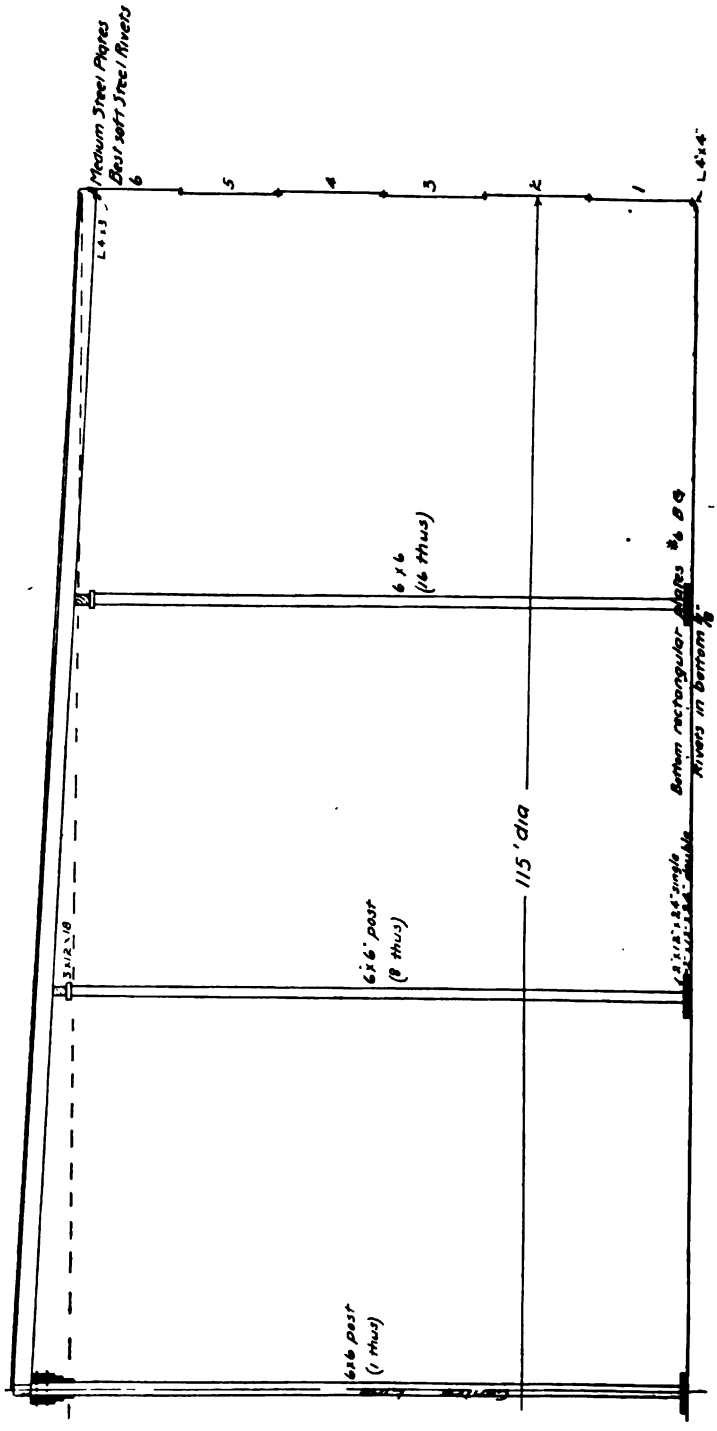
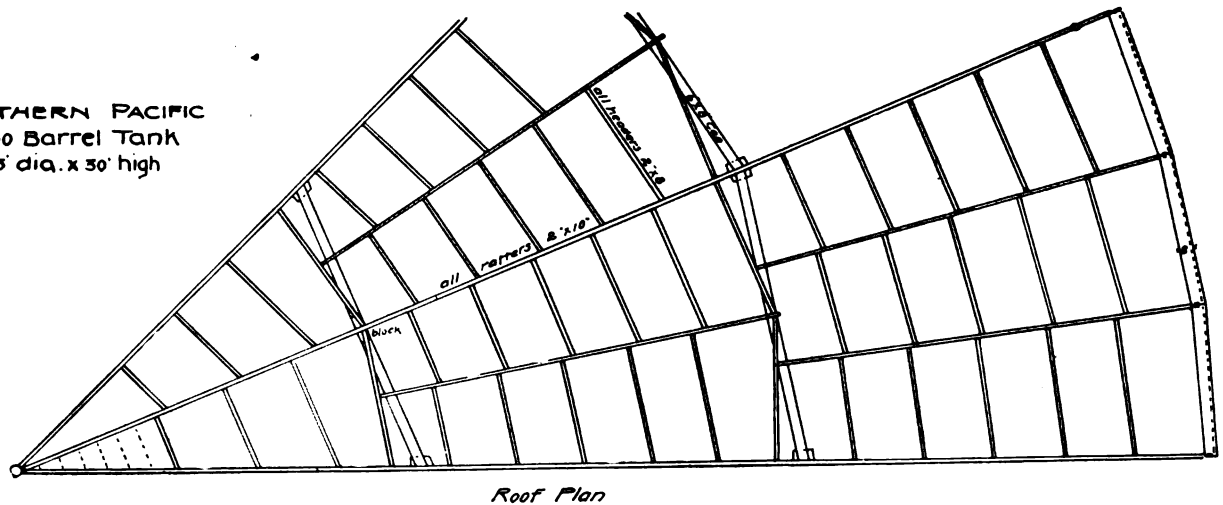


FIG. 65.—Fifty-five thousand bbl. Tank, Southern Pacific Co.



Number of ring	Thickness of plates inch	B G
6	3/16	
5	0.203	6
4	0.238	4
3	0.34	0
2	0.454	0000
1	5/16	

FIG. 66.—Roof Detail, 55,000 bbl. Tank, Southern Pacific Co.

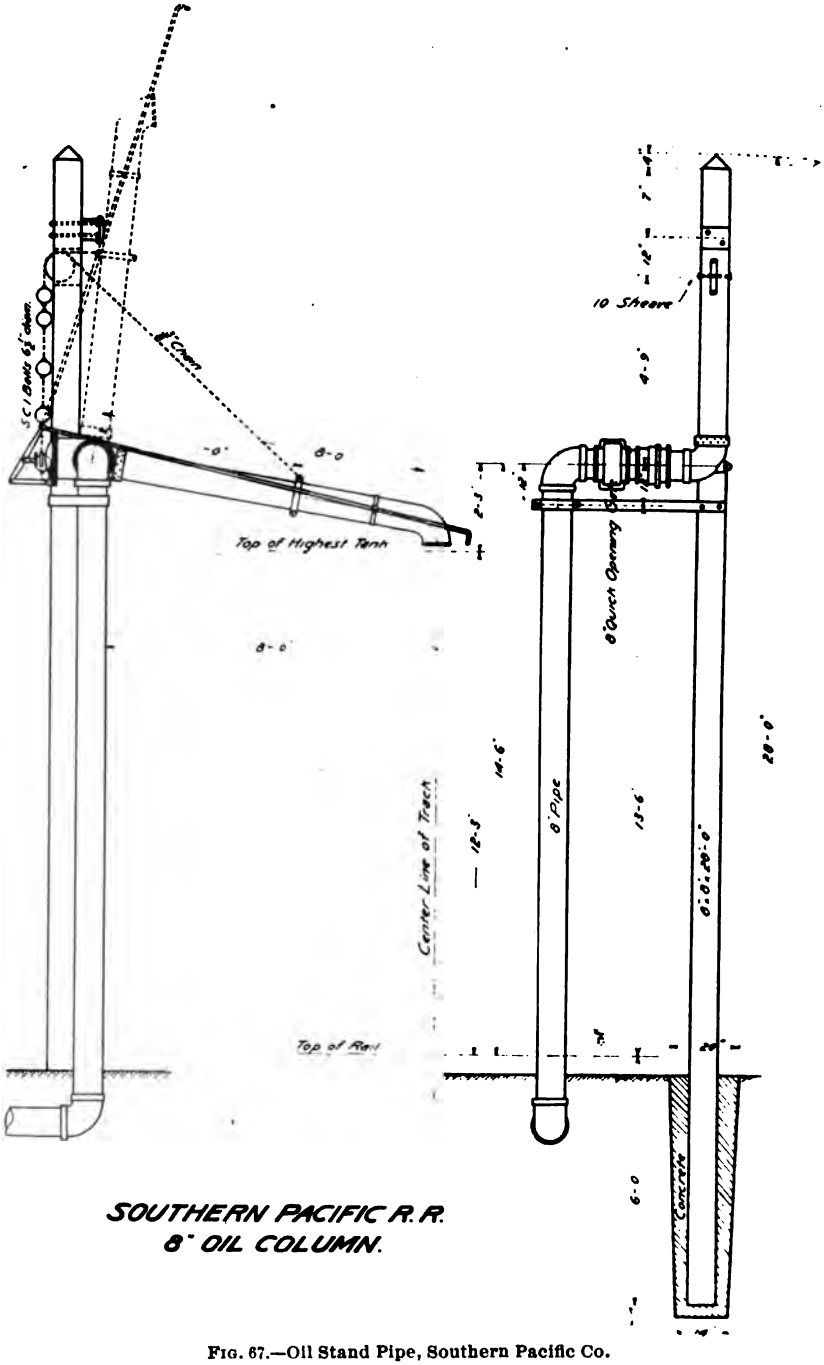
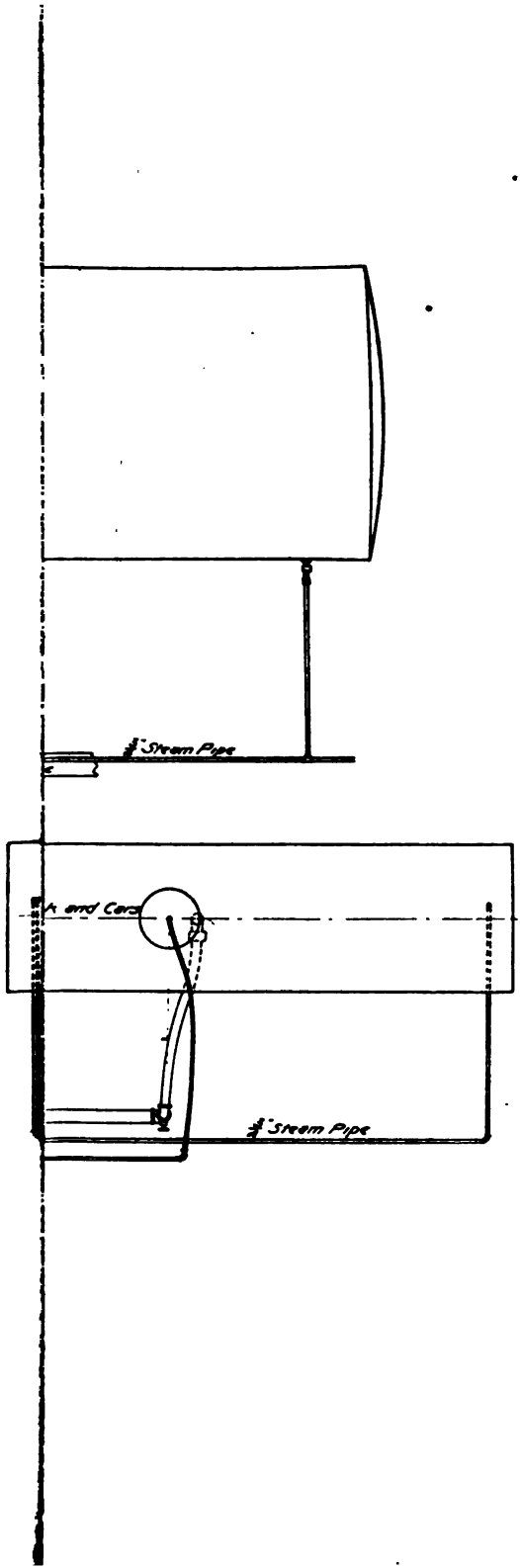


FIG. 67.—Oil Stand Pipe, Southern Pacific Co.


Steam Pipe
Steam Pipe

SPECIFICATIONS FOR STORAGE TANK FOR OIL FOR SOUTHERN PACIFIC COMPANY.

Estimated capacity, 37,500 barrels.

Dimensions: 95 feet and 4 inches diameter and 30 feet in height.

Foundations: All foundations to be graded and completed by railroad company.

Material: Tank steel, American Steel Manufacturers' Association standard specifications.

All material, as to quality and dimensions, subject to inspection and acceptance at the mill where the materials are made before any constructional work is commenced; all cost of inspection to be paid by first party.

Thickness of material:

Bottom plates, sketch No. 4 gauge; diameter of rivets, ⅞ inch.

Bottom plates, rectangular 3-16 gauge; diameter of rivets, ⅞ inch

Bottom angles, 4x4x½ inches gauge; diameter of rivets, 11-16 inch.

First ring, 000 gauge; diameter of rivets, 11-16; cross seams double riveted.

Second ring, 0 gauge; diameter of rivets, 11-16; cross seams double riveted.

Third ring, 1 gauge; diameter of rivets, ⅞; cross seams double riveted.

Fourth ring, 3 gauge; diameter of rivets, ⅞; cross seam single riveted.

Fifth ring, 4 gauge; diameter of rivets, 7-16; cross seams single riveted.

Sixth ring, 6 gauge; diameter of rivets, 7-16; cross seams single riveted.

Top angles, 3x3x5-16 inches, or ⅞ inches; diameter of rivets, 7-16.

Steel sheeting, No. 20 gauge, laid on tar paper, and nailed with 3-penny nails.

Roofing: Roofing to be built of 6x6 inches posts, 5x12 inches beams, 2x8 inches rafters and sills, 1x8 inches or 12 inches wood sheeting, 1x6 inches braces.

SPECIFICATIONS FOR STORAGE TANKS FOR OIL FOR SOUTHERN PACIFIC COMPANY.

Estimated capacity, 55,000 barrels.

Dimensions: 114 feet and 6 inches diameter by 30 feet in height.

Foundations: All foundations to be graded and completed by railroad company.

Material: Tank steel, American Steel Manufacturers' Association standard specifications.

All material, as to quality and dimensions, subject to inspection and acceptance at the mill where the materials are made before any constructional work is commenced; all cost of inspection to be paid by first party.

Thickness of material:

Bottom plates, sketch No. 4 gauge; diameter of rivets, ⅞ inch.
Bottom plates, rectangular No. 6 gauge; diameter of rivets, ⅞ inch.
Bottom angles, 4x4x½ inches gauge; diameter of rivets, ¾ inch.
First ring, 23-lb. square feet; diameter of rivets, ¾; cross beams triple riveted.
Second ring, 19-lb. square feet; diameter of rivets, ¾; cross beams triple riveted.
Third ring, 14-lb. square feet; diameter of rivets, 11-16; cross beams double riveted.
Fourth ring, 12-lb. square feet; diameter of rivets, ½; cross beams double riveted.
Fifth ring, 10-lb. square feet; diameter of rivets, 7-16, cross beams single riveted.
Sixth ring, 8-lb. square feet; diameter of rivets, 7-16; cross beams single riveted.
Top angles, 3½x3x5-16 inches or ⅞ inches; diameter of rivets, 7-16 inch.
Steel sheeting, No. 20 gauge, laid on tar paper, and nailed with 3-penny nails.

Roofing: Roofing to be built 6x6 inches posts; 5x12 inches beams, 2x8 inches rafters and sills, 1x8 inches or 12 inches wood sheeting, 1x6 braces.

Following applies to 30,000, 37,500, and 55,000 barrel capacity tanks alike:

Man head: Man head in bottom ring, 20-inch diameter.

Flanges: Tanks to have one 8-inch, one 6-inch, and one 2½-inch each.

Hatches: Tanks to have one hatch in roof, 24 inches long and 18 inches wide, complete with cover each.

Wooden stairway: Tank to have wooden stairway made, 2x12 inches plank, 2x3 inches steps erected in place, each.

Riveting: All rivets over 7-16 inches to be driven hot. All rivets to be driven on the inside of tanks.

Calking: All calking to be done with a round-nosed tool, inside of tanks.

Workmanship: To be first class, and tanks to be guaranteed tight.

Painting: Tanks to receive, upon completion, one coat of red mineral paint.

Windlasses: Tanks to have windlass complete, with stand and wheel for top of tank, and galvanized ⅝-inch cable connected with pipe by a 2-inch by ¼-inch clamp.

Pipe and fittings: Tanks to have all inside pipe fittings and connections complete, ready for outside pipe connections.

Gauge: Tanks to have float gauge connected with outside measurement board.

SOUTHERN PACIFIC COMPANY.

SAN FRANCISCO, CAL., Aug. 17, 1903.

Mr. C. C. Mallard, Lafayette, La.

DEAR SIR: Referring to your favor of July 16, our system so far for storing fuel oil consists in steel oil tanks containing anywhere from 5,000 to 55,000 barrels capacity. The oil is distributed to locomotives from auxiliary tanks by means of compressed air.

I send you herewith a set of blue prints and plans showing this arrangement; also plan of our latest oil tanks and location plan showing relative position of stand pipes for water and oil.

Yours truly,

JOHN D. ISAACS,
Asst. Engr. M. of W.

THE ATCHISON, TOPEKA & SANTA FE RAILWAY COMPANY.

TOPEKA, KAN., Aug. 14, 1903.

Mr. C. C. Mallard, A. A. Supt. Louisiana & Western Ry. Co., Lafayette, La.

DEAR SIR: Referring to your letter of July 20 to Mr. James Dun, chief engineer of the system, I hand you herewith drawing showing methods of storing fuel oil with appliances for supplying locomotives on our Gulf, Colo. & Santa Fe line.

In regard to plans for water stations, would say that we at present use steel tanks. We have three different sizes as to height, all of which are 24 feet in diameter. They are 29, 43, and 60 feet high. These tanks have concrete in the bottom up for about 4 feet, so as to make the bottom slope to a manhole in one side, for the purpose of washing out mud and silt that deposits in them.

The tank spouts are attached to the sides of these tanks, at

the proper height for our highest locomotives, so that the available water space is from this attachment to the top of the tank, the lower part serving as a catch basin for the sediment to settle in.

We have no fixed plan for the establishment of these tanks. In some cases they are erected by the side of the main track, while in other places they are erected back at some convenient point where they will be out of the way of tracks, and water is taken from cranes, usually erected at the proper distance for passenger trains to take water while the cars are opposite the depot platform.

On the high tanks we figure on using a 10-inch connection while on the lower tanks we use a 12-inch connection. We are at present using 10-inch water cranes on our important main lines and figure on taking a 6,000 gallon tank of water in one minute.

Our coaling stations are supplied with gravity chutes. The hopper bottom cars are drawn to the top of an incline built to an angle of about 45 degrees, with a Lidgerwood machine, operated by gasoline or steam, according to its location. When near shops where we have plenty of steam it is operated by steam, but at stations where there is no steam plant already located we operate it with gasoline engine and have found the service very satisfactory, having reduced the price of handling coal on an average of about 6 cents a ton by the installation of this plant.

Hoping this information will be of service to you, I remain,

Very truly yours,

C. A. MORSE,
Acting Chief Engineer.

BOSTON & MAINE RAILROAD.

BOSTON, MASS., July 28, 1903.

Mr. C. C. Mallard, Louisiana Western R. R. Co., Lafayette, La:

DEAR SIR: Answering your letter of July 20th, regarding storage of fuel oil, I send you in another cover three prints, showing the plant which we have at Hoosac tunnel for supplying engines with fuel oil which haul our trains through the tunnel. The plans are complete enough, I think, so that they need no explanation. We do not attempt to use the same standpipes for water. That is arranged for by an entirely different plant. We have only one of these stations on the road, as we burn oil only for the special purpose of avoiding coal smoke in the long tunnel.

Yours truly,

J. P. SNOW,
Bridge Engineer.

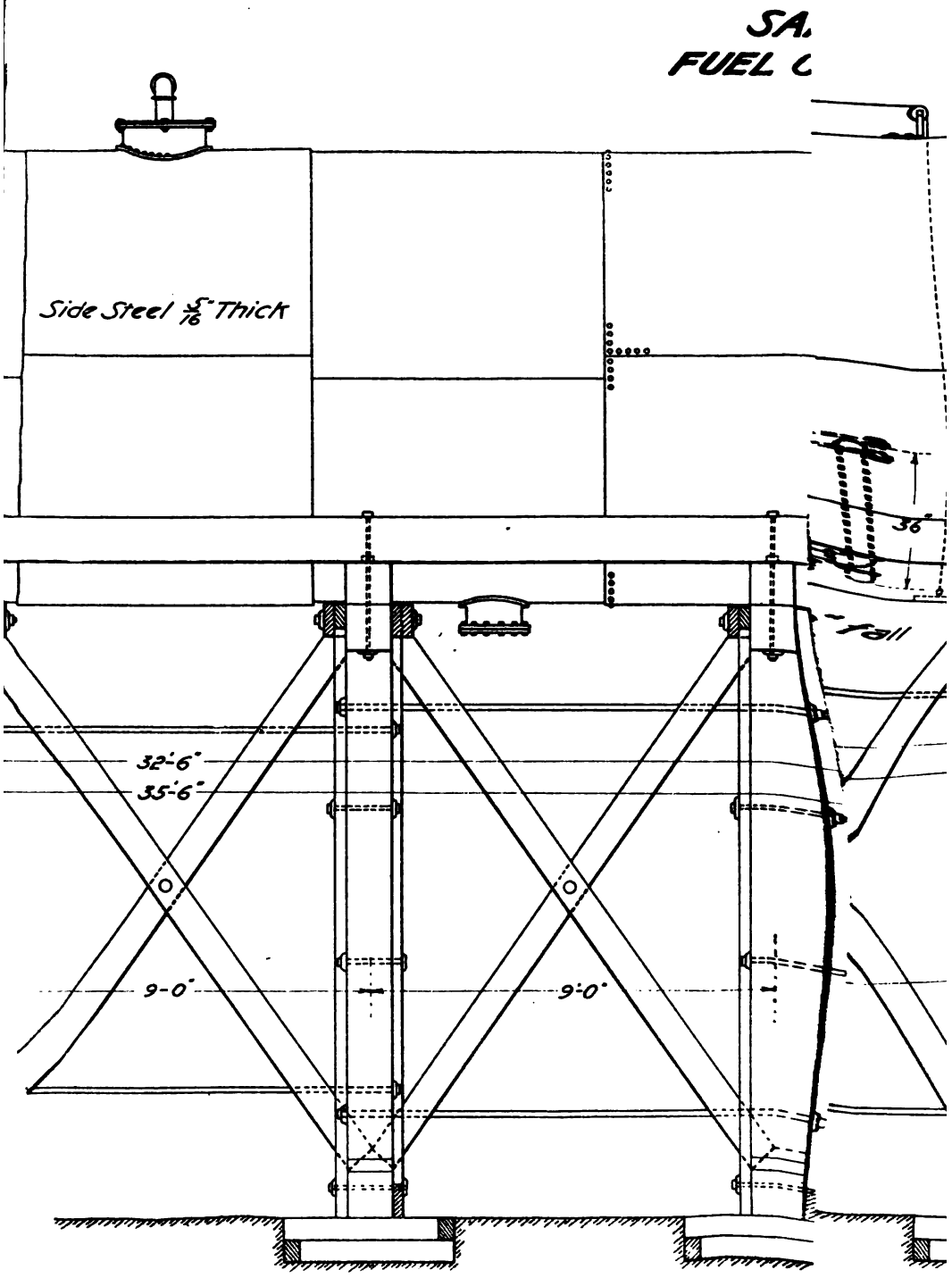
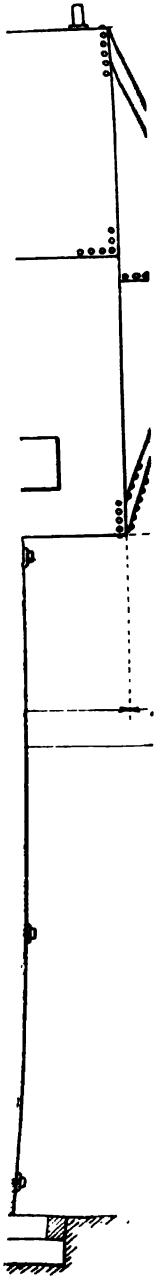
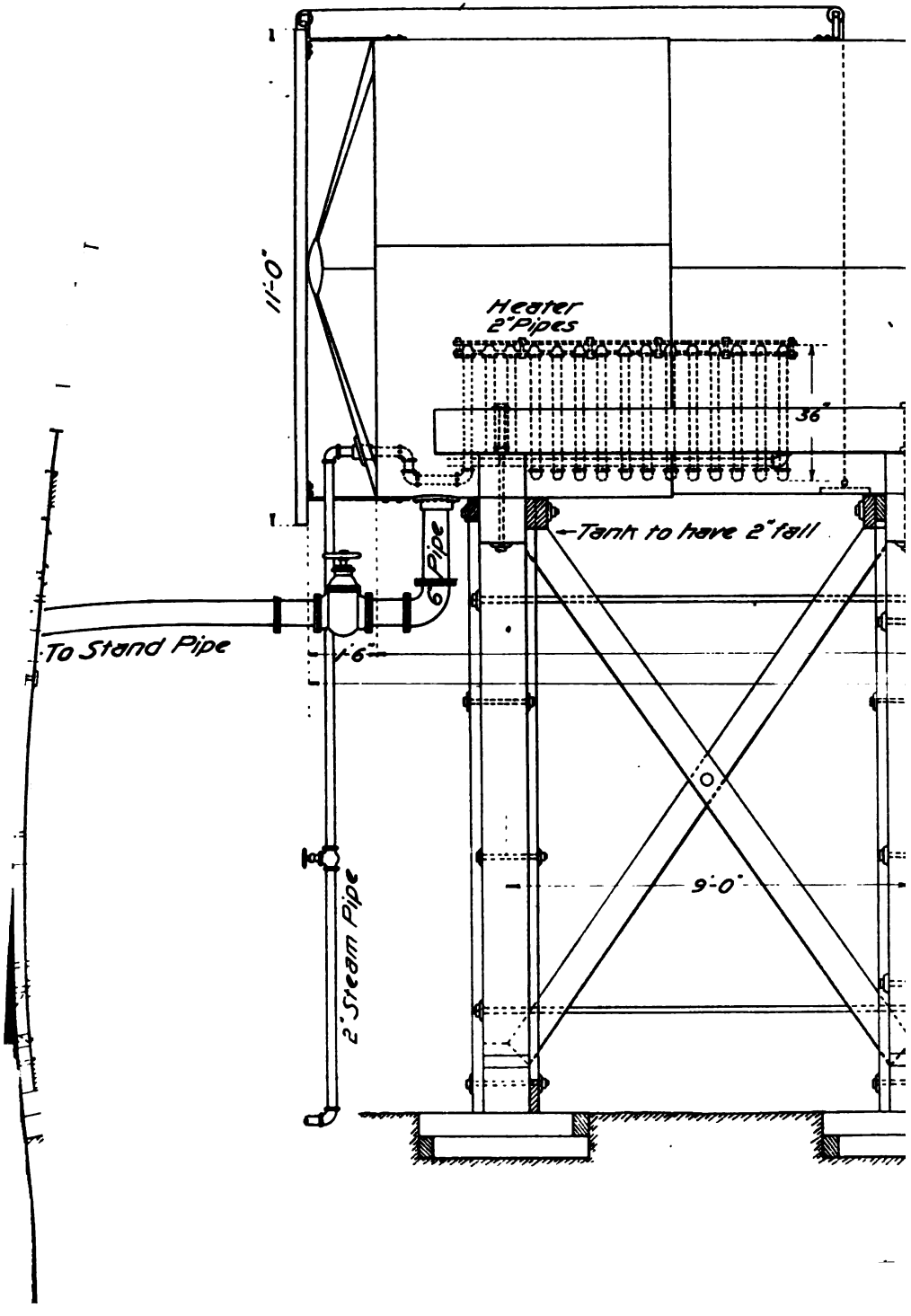
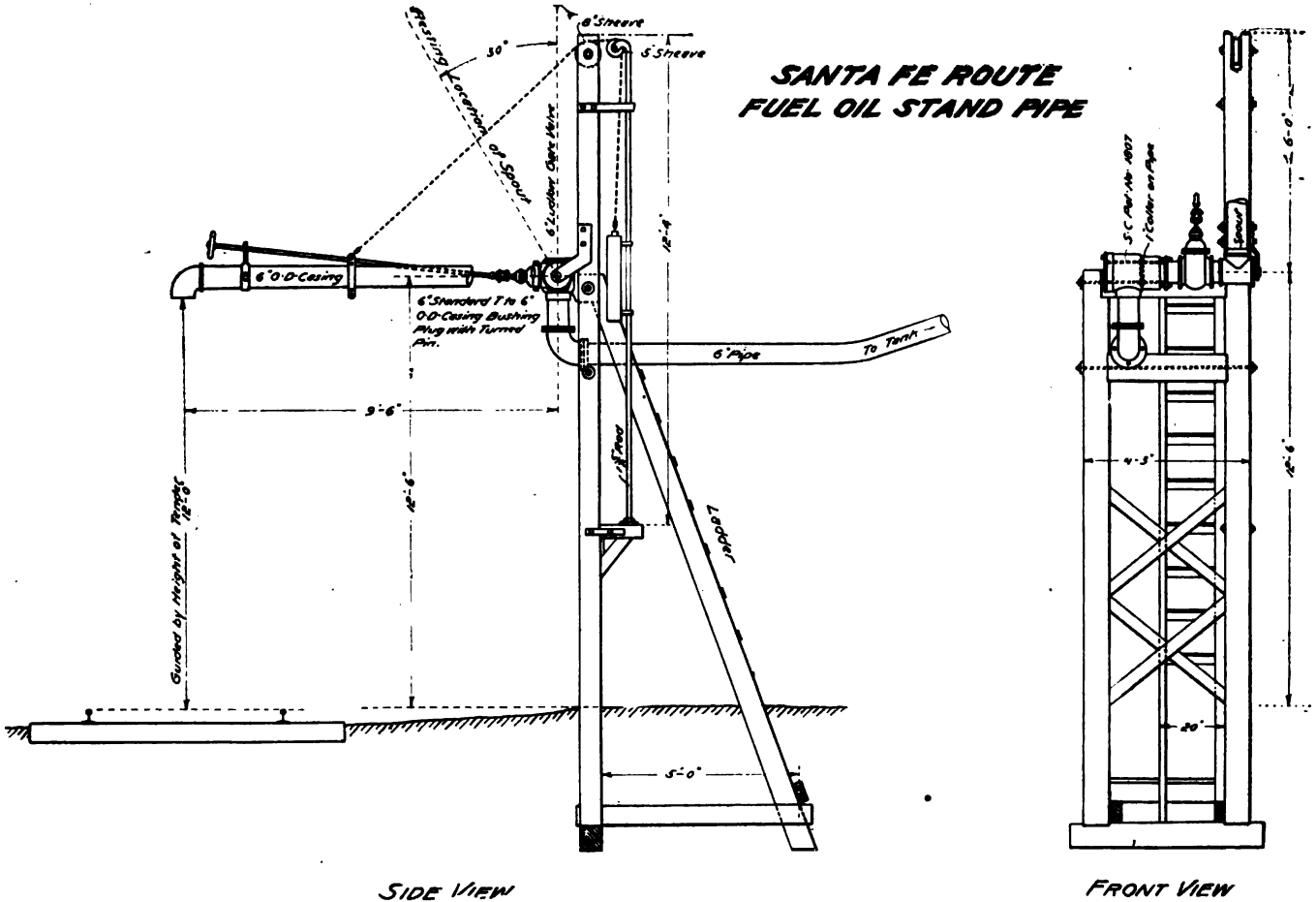


FIG. 69. Fuel Oil Delivering Tank, Santa Fe Route.

NTA /
7IL DE.




11'-0"
Heater
2" Pipes
36"
Tank to have 2" fall
6" Pipe
To Stand Pipe
1'-6"
2" Steam Pipe
9'-0"



SIDE VIEW

FRONT VIEW

Fig. 70. Fuel Oil Stand Pipe, Santa Fe Route.

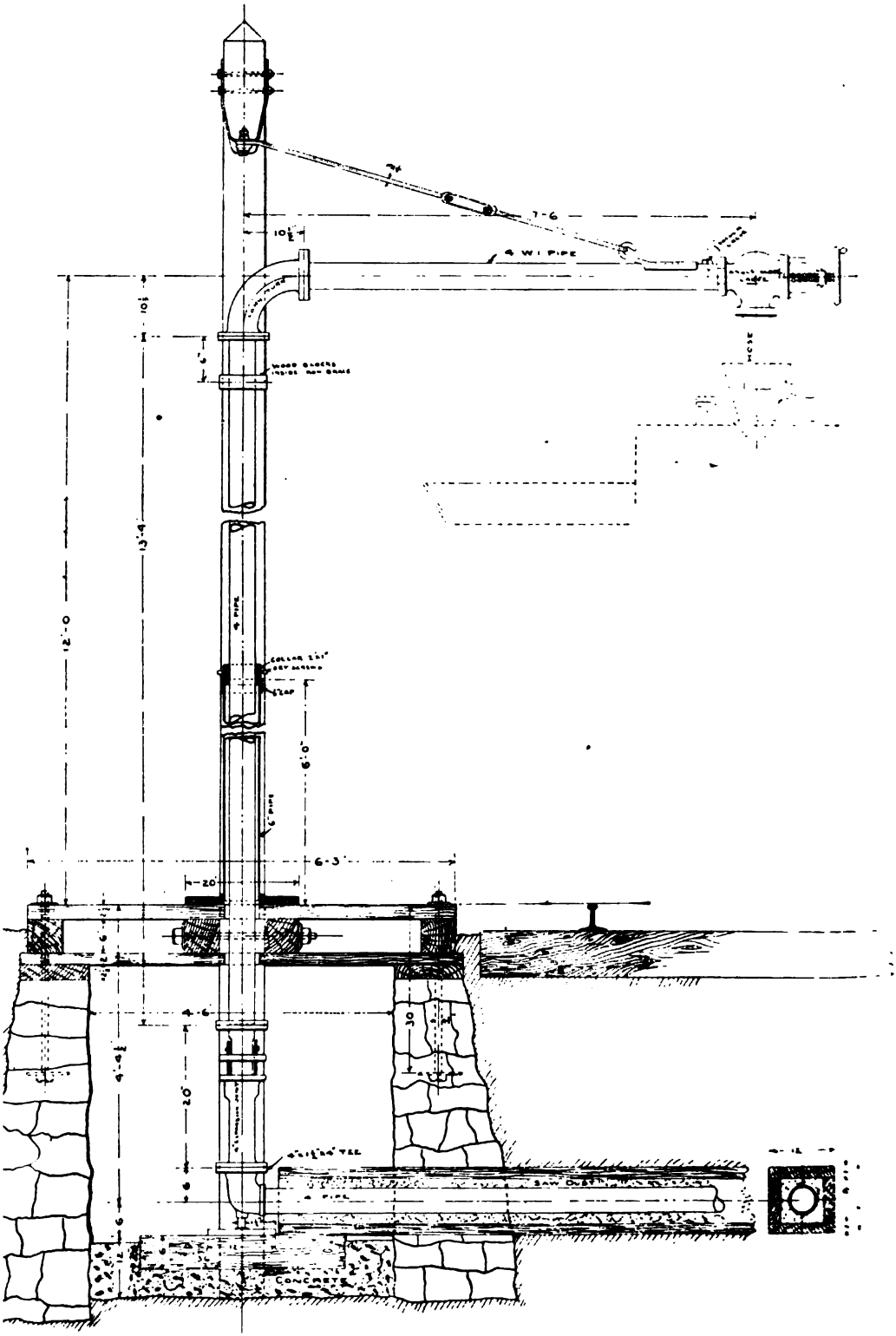


Fig. 71. Oil Stand Pipe, Hoosac Tunnel, Boston & Maine R. R.—Side View.

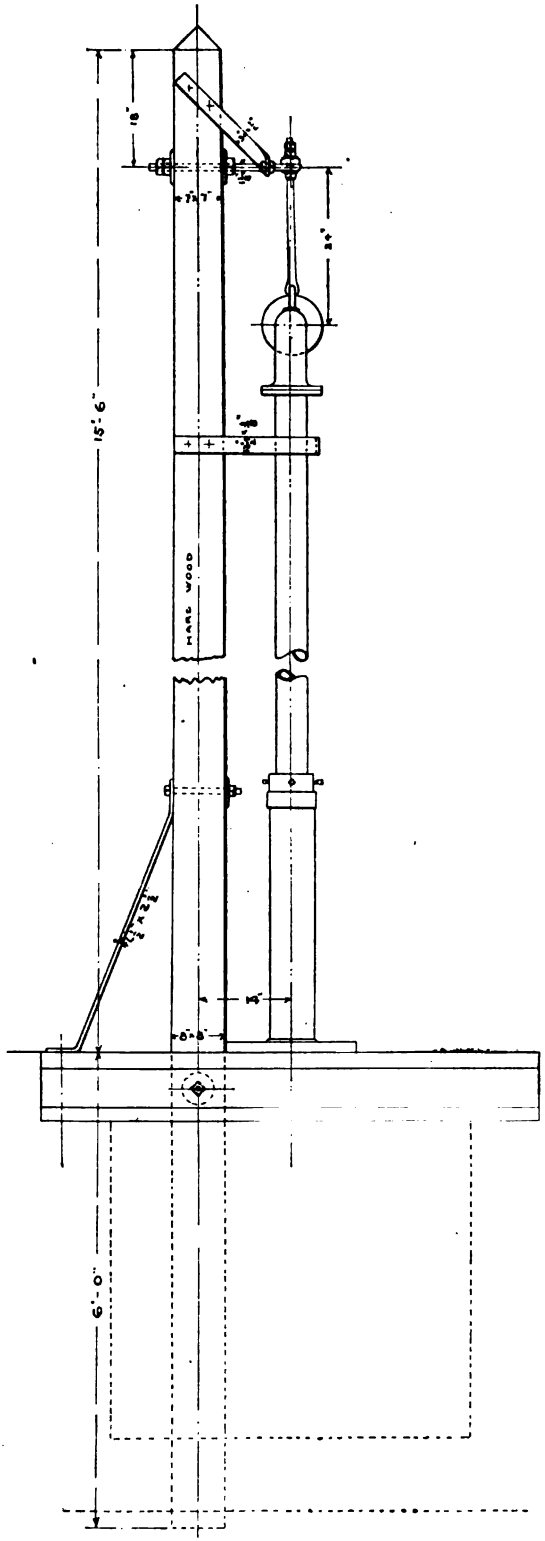
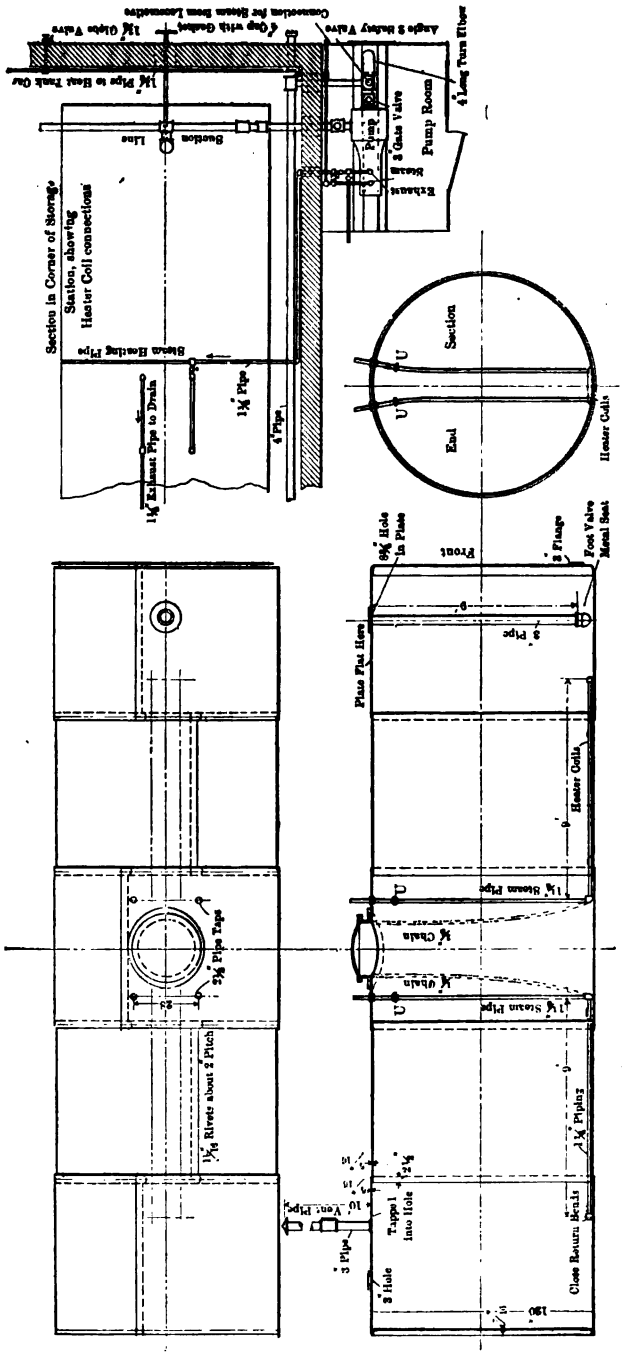


Fig. 72. Oil Stand Pipe, Hoosac Tunnel, Boston & Maine R. R.—Front View.

By courtesy of American Engineer and Railroad Journal

FIG. 73. East Portal, Hoosac Tunnel, B. & M. R. R.



By courtesy of American Engineer and Railroad Journal.

FIG. 74. Detail of Oil Storage Tank, Hoosac Tunnel, B. & M. R. R.

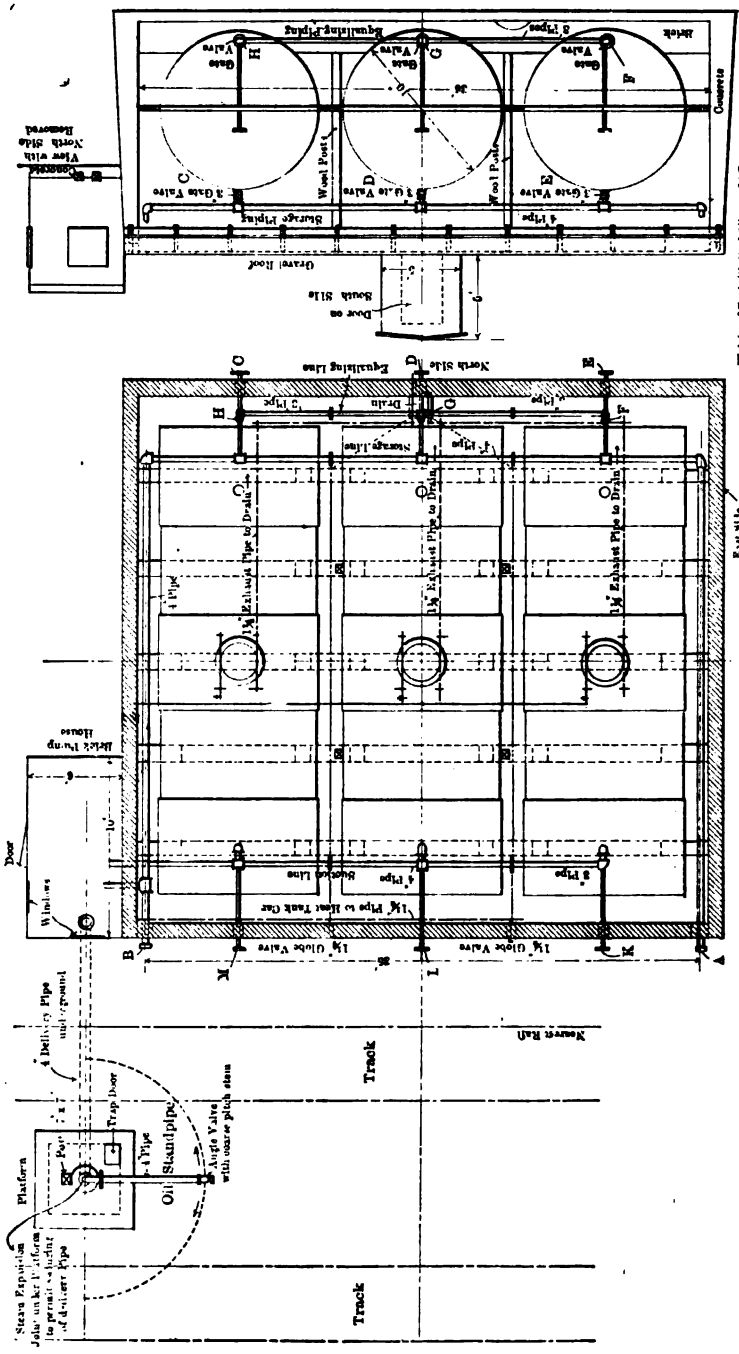
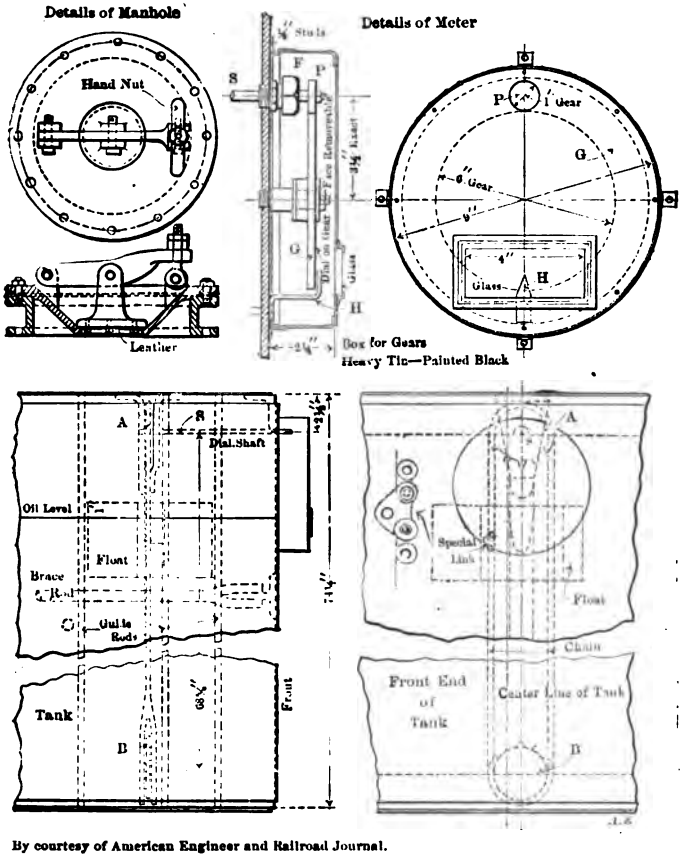


Fig. 75. Oil Storage Pit, Hoosac Tunnel, B. & M. R. R.

By courtesy of American Engineer and Railroad Journal.



By courtesy of American Engineer and Railroad Journal.

FIG. 76. Tank Details on Locomotive, Hoosac Tunnel Route, B. & M. R. R.

SUBJECT NO. 4.—WHAT IS THE BEST FORM OF TRAVELER TO BE USED IN ERECTING STEEL RAILWAY BRIDGES OF SPANS UP TO TWO HUNDRED FEET.

No report from committee. The following letter from Mr. F. S. Edinger, of the Southern Pacific Co., is submitted:

SAN FRANCISCO, Sept. 19, 1903.

To the Committee on Subject No. 4, Association of Railway Superintendents of Bridges and Buildings:

GENTLEMEN: As the subject to be reported on by your committee is one in which I am very much interested, I am sending you some drawings, photographs, and a description of the traveler used by me in the erection of short steel railway bridges for the past nine years.

This traveler has proved very economical and convenient in such work, though not admitting of great increase of force where work is to be rushed.

In 1894, realizing that the erection of the straddle traveler and the special falsework for the accommodation of same was a work of nearly as much magnitude as the erection of the span itself, I concluded that these spans might, to advantage, be erected from the inside by means of a traveler so arranged as to occupy the track during the intervals between the passing of trains, for in the case of renewals of spans on operated line of which our work mainly consisted, it was necessary that the track be maintained, and it could be used by the traveler without any additional cost for falsework.

Another item of expense which I wished to reduce was the handling of the material from ashore to where it could be reached by the traveler, which where using the straddle traveler required either a locomotive crane or a standing derrick and a number of men to load the material on cars and run it out on the falsework.

I aimed in designing the traveler to do all of the handling, transportation, and erection with it, and as few men as possible, and have it a suitable and convenient appliance for the erection of all kinds of spans, yet of such dimensions that it could pass over any portion of the road, through tunnels, bridges, and snow sheds, and be ready for instant use at all times.

The first one was built of wood and iron, which, after having been in almost constant use for six years, was in such condition as to require renewal. The results obtained from its use were so satisfactory and the amount of bridge work before us so great as to warrant the construction of the new one in metal which was done as per accompanying outline drawing.

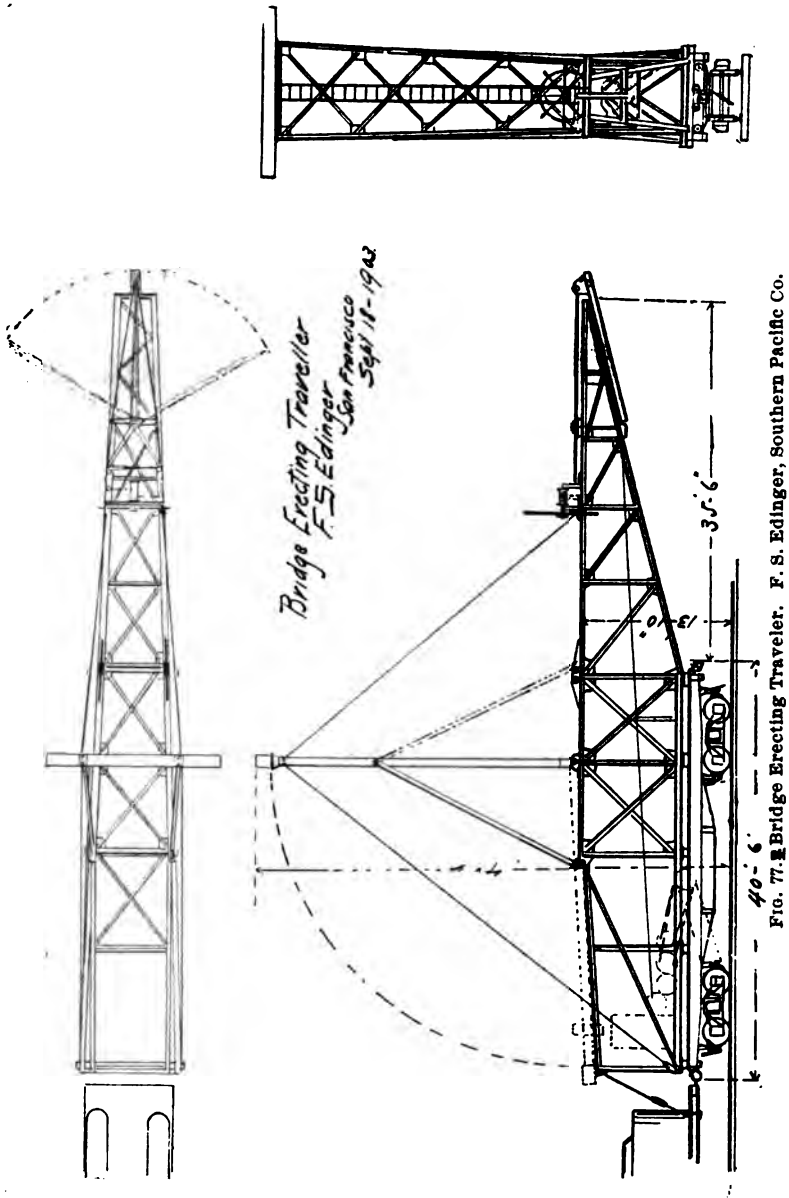


FIG. 77.—Bridge Erecting Traveler. F. S. Edinger, Southern Pacific Co.

The traveler is self-propelling and its stability is such that no anchorage is required under any condition of loading up to that for which it is designed, leaving it free to move along the track at all times with its suspended loads. The overhanging trusses have a capacity of twenty tons suspended from the extreme end. The swinging boom has a capacity of eight tons at all points within eight feet from the center of the track and a capacity of five tons when standing at right angles to the track, or fourteen feet from center of track. The boom is swung and held to any position by means of a steering wheel and drum operated by hand.

The tower is hinged to the top chords of the trusses and folds back over the engine when not in use, and the cap is taken off and carried on the tender.

It is provided with an adjustable staging from which to drive the pins of through pin-connected spans and is guyed fore and aft with wire cable guys when handling heavy material, but is supported by a stiff leg on both sides which can be set either fore or aft when putting in top laterals or other light material if the guys are in the way.

The tower has a capacity of ten tons on each or both projecting ends of the cap.

The hoisting engine has two drums and four winches, all arranged to wind or hold independently, and it also drives the propelling mechanism of spocket chains and wheels operated by means of clutches.

An ordinary locomotive tender accompanies the traveler at all times, and is utilized as counterweight when handling heavy loads suspended from the ends of overhanging trusses.

The overhanging ends of the trusses are detachable and are carried on a tool car when moving long distances in regular trains as the swaying of the overhanging weight is likely to break the flanges on the wheels of the front truck. It is disconnected by removing the drawhead, which is especially constructed to facilitate the operation, bringing the two cars together so that the overhang rests on permanent blocking (fixed to the tool car) removing the pins connecting the overhang, separating the cars and replacing the drawhead. This gives the separated trusses sufficient clearance so that they will not interfere on the sharpest curve.

Deck plate girders up to forty-five feet in length are riveted together and handled in pairs, suspended at their centers, from the end of the overhang, the track having been first removed in sections of a rail length each with the ties all spiked to the rails. Girders from forty-five to seventy feet are handled singly, suspended at their centers from the overhang, the riveting being done after they are under the track.

Through bridges are erected by first placing the floor system on the falsework in the same manner as girders excepting that the beams and stringers are handled by the boom. The web

members, top chord, and end posts are raised from the tower and the top laterals are put in with a light boom stepped at the foot of the tower on either side of same as may be desired.

Deck truss spans are erected with the boom on the overhang.

The light material is loaded on flat cars by the traveler and most of it taken direct from the cars and put in place. The material for through trusses has to be strung along on the falsework or the ends of the floor beams in order to raise it with the tower. The top chord is picked up ashore high enough to clear the tops of the posts and carried out, a section on each side of the tower. The diagonal bars in pin-connected spans are secured to the heads of the posts by wooden pins until the top chord is lowered over them and the steel pins put in.

Everything is handled by steam, both ashore and on the bridge, reducing the number of men to the minimum, which in these days of high wages is quite an item.

All tackle and blocks are permanently hung in iron straps or shackles and do not have to be moved around and hung in insecure lashings, so that the element of danger due to the use of light lashings and insecure fastenings is practically nothing, and the men work around it with perfect confidence knowing that everything has been tested to the limit frequently, and not found wanting in strength as is sometimes the case where temporary travelers or staging is put to use for the first time and a bolt is left out or something not equal to the strains put upon it.

The first cost of the trusses for such a traveler built of wood and iron is no greater than for any other traveler, and it can be removed from the car and stored without taking it apart.

The first bridge erected with this traveler was a 208-foot through pin-connected span, and the cost of erection was only forty per cent. of that of a similar span erected with straddle traveler. Eight men with this traveler can erect any ordinary span.

Photographs 373, 374, and 375 show the new traveler used in the erection of a 200-foot through span over Klamath river.

Photograph No. 24 shows the old traveler used in the erection of a 196-foot span over Alameda creek.

Photograph No. 75 shows the erection of some 140-foot deck spans with 50-foot girder approaches over Pajaro river.

F. S. EDINGER.

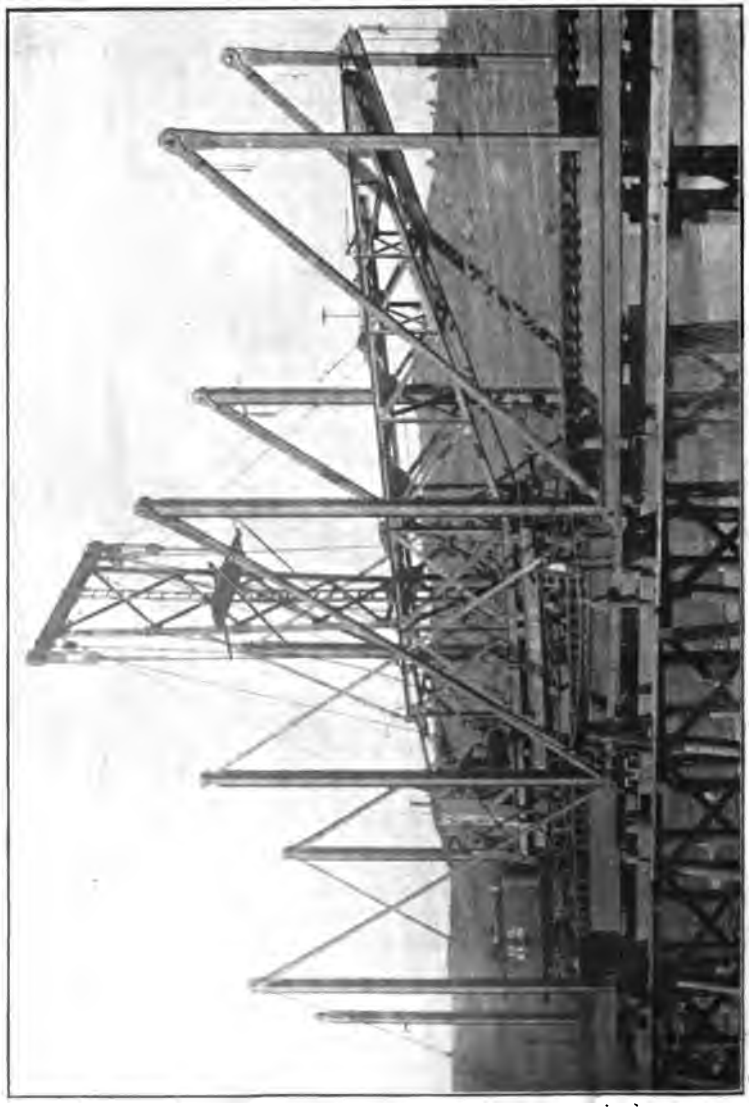


FIG. 78. Bridge Erecting Traveler. F. S. Edinger, Southern Pacific Co.

Fig. 79. Bridge Erecting Traveler. F. S. Edinger, Southern Pacific Co.

Fig. 80. Bridge Erecting Traveler. F. S. Edinger, Southern Pacific Co.

FIG. 81.—Bridge Erecting Traveller.—F. S. Edinger, Southern Pacific Co.

FIG. 82.—Bridge Erecting Traveller. F. S. Edinger, Southern Pacific Co.

LIST OF ANNUAL CONVENTIONS.

First Convention,	St. Louis, Mo.,	September 25, 1891.
Second Convention,	Cincinnati, Ohio,	October 18, 19, 1892.
Third Convention,	Philadelphia, Pa.,	October 17 to 19, 1893.
Fourth Convention,	Kansas City, Mo.,	October 16 to 18, 1894.
Fifth Convention,	New Orleans, La.,	October 15, 16, 1895.
Sixth Convention,	Chicago, Ill.,	October 20 to 22, 1896.
Seventh Convention,	Denver, Col.,	October 19 to 21, 1897.
Eighth Convention,	Richmond, Va.,	October 18, 19, 1898.
Ninth Convention,	Detroit, Mich.,	October 17, 18, 1899.
Tenth Convention,	St. Louis, Mo.,	October 16 to 18, 1900.
EleventhConvention,	Atlanta, Ga.,	October 15 to 17, 1901.
Twelfth Convention,	Minneapolis, Minn.,	October 21 to 23, 1902.
Thirteenth Convention,	Quebec, Canada,	October 20 to 22, 1903.

MEMBERSHIP.

Year 1891–2. . . .	Number of active members, 60.
Year 1892–3. . . .	Number of active members, 112.
Year 1893–4. . . .	Number of active members, 128.
Year 1894–5. . . .	Number of active members, 115.
Year 1895–6. . . .	Number of active members, 122.
Year 1896–7. . . .	Number of active members, 140.
Year 1897–8. . . .	Number of active members, 127.
Year 1898–9. . . .	Number of active members, 148.
Year 1899–1900. . .	Number of active members, 148.
Year 1900–01. . . .	Number of active members, 143.
Year 1901–02. . . .	Number of active members, 171.
Year 1902–03. . . .	Number of active members, 195.
Year 1903–04. . . .	Number of active members, 223.

LIST OF OFFICERS OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS FROM ITS ORGANIZATION TO THE YEAR 1903-1904.

YEAR.	1891-2.	1892-3.	1893-4.	1894-5.
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews.
First Vice-President	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle.
Second Vice-President	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford.
Third Vice-President	James Stannard	N. W. Thompson.	L. K. Spafford	James Stannard.
Fourth Vice-President	G. W. Hinman	C. E. Fuller	E. D. Hines	Walter G. Berg.
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid.
Executive Members.	W. R. Damon	G. W. Andrews	Quintine McNab	James Stannard.
	G. W. Markley	Joseph M. Staten.	Aaron S. Markley	James H. Travis.
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	Joseph H. Cummin.
	G. W. McGehee	Quintine McNab.	James Stannard	R. M. Peck.
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White.
	J. E. Wallace	Aaron S. Markley	Joseph H. Cummin	A. Shane.

YEAR.	1895-6.	1896-7.	1897-8.	1898-9.
President	W. A. McGonagle	James Stannard	Walter G. Berg	Joseph H. Cummin.
First Vice-President	L. K. Spafford	Walter G. Berg	Joseph H. Cummin	Aaron S. Markley.
Second Vice-President	James Stannard	Joseph H. Cummin	Aaron S. Markley.	C. C. Mallard.
Third Vice-President	Walter G. Berg	Aaron S. Markley	G. W. Hinman	Walter A. Rogers.
Fourth Vice-President.	Joseph H. Cummin	R. M. Peck	C. C. Mallard	Joseph M. Staten.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members.	R. M. Peck	W. O. Eggleston	George J. Bishop	Wm. S. Danes.
	J. L. White	W M. Noon	C. P. Austin	J. H. Markley.
	A. Shane	Joseph M. Staten	M. Riney	W. O. Eggleston.
	Aaron S. Markley	George J. Bishop	Wm. S. Danes	R. L. Heflin.
	W. M. Noon	C. P. Austin	J. H. Markley	Frank W. Tanner.
	Joseph M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman.

LIST OF OFFICERS OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS FROM ITS ORGANIZATION TO THE YEAR 1903-1904.

Year.	1899-1900.	1900-1901.	1901-1902.	1902-1903.
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering.
First Vice-President	Walter A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard.
Second Vice-President	Joseph M. Staten	B. F. Pickering	A. Shane	A. Shane.
Third Vice-President	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman.
Fourth Vice-President	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	N. W. Thompson.	N. W. Thompson.	N. W. Thompson.	N. W. Thompson.
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith.
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick.
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin.
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty.
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston.
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley.

Year.	1903-1904.	1904-1905.	1905-1906.	1906-1907.
President	B. F. Pickering			
First Vice-President	A. Shane			
Second Vice-President	C. A. Lichty			
Third Vice-President	J. B. Sheldon			
Fourth Vice-President	J. H. Markley			
Secretary	S. F. Patterson			
Treasurer	C. P. Austin			
Executive Members	R. H. Reid			
	W. O. Eggleston			
	A. E. Killam			
	R. C. Sattley			
	H. Rettinghouse.			
	J. S. Lemond			

SUBJECTS FOR REPORT AND DISCUSSION, AND COMMITTEES SELECTED AT EACH CONVENTION SINCE ORGANIZATION OF THE ASSOCIATION IN 1891.

FIRST CONVENTION, ST. LOUIS, MO., SEPTEMBER 25, 1891.

Subjects.	Committees.
1.	
Surface Cattle-Guards	Aaron S. Markley, J. B. Mitchell, W. R. Damon.
2.	
Frame and Pile Trestles Complete, including Rerailer	H. M. Hall, W. A. McGonagle, G. W. McGehee.
3.	
Framing and Protection of Howe Truss and Other Wooden Bridges against Fire and Decay	J. E. Johnson, G. W. Markley, J. H. Markley.
4.	
Iron and Vitrified Pipe for Waterways under Railroad Embankments	James Stannard, J. O. Thorn, J. E. Wallace.
5.	
Water-Tanks Complete, including Painting, Pumps, Pump and Coal Houses, Wells and Reservoirs	G. W. Turner, R. K. Ross, Q. McNab.
6.	
Interlocking Signals	B. F. Bond, G. W. Hinman, James Demars.
7.	
Depot Platforms, Complete	J. A. Nicholson, Adam McNab, C. B. Keller.
8.	
Paints for Iron Structures	Geo. M. Reid, A. J. Kelley, H. A. Hanson.

SECOND CONVENTION, CINCINNATI, O., OCTOBER 18 AND 19, 1892.

1.	
Discipline, and Benefits Derived, and Who are the Beneficiaries	Geo. W. Andrews, W. R. Damon, T. M. Strain, G. W. Turner.
2.	
Turn-table, Best, with a View of Economy, and Durability, and Strength	G. W. Markley, H. F. Martin, James H. Travis, Charles Walker.
3.	
Water Columns, Best, Cheapest, Simplest, and Most Durable	C. E. Fuller, A. S. Markley, H. N. Spaulding, E. L. Cary.
4.	
Coaling Stations, including Storage Bins and for Coaling Engines	J. E. Wallace. C. W. Gooch, G. W. Hinman, J. H. Cummin.

5.		
Crawling of Rails, and its Effects on Structures.....	Geo. M. Reid, L. K. Spafford, J. B. Mitchell, L. S. Isdell.	
6.		
Guard-Rails on Bridges, Advantages and Disadvantages, and Best to be Adopted.....	O. J. Travis, Q. McNab, J. F. Mock, J. M. Staten.	
7.		
Platforms, Height and Distance from Rail and Mode of Construction.....	James Stannard, M. Walsh, N. M. Markley, Robert Ogle.	
8.		
Best Bridge, Wood, Combination, or Iron, from 130 feet and upwards, and the Best Method of Reconstruction.....	A. Shane, Walter Ransom, N. Potter, C. G. Worden.	
9.		
Best Method of Elevating Track upon Bridges and Trestles.....	H. E. Gettys, S. F. Patterson, G. W. Hinman, P. A. Watson.	

THIRD CONVENTION, PHILADELPHIA, PA., OCT. 17, 18, AND 19, 1893.

1.		
Depressed Cinder Pits and Other Kinds.....	W. G. Berg, Abel S. Markley, G. W. Andrews, C. E. Fuller.	
2.		
Best Method of Bridge Inspection.....	G. M. Reid, J. M. Staten, E. T. Wise, J. S. Berry.	
3.		
Pumps and Boilers.....	G. W. Markley, G. W. Turner, J. B. Mitchell, J. R. Harvey.	
4.		
Maintenance of Pile and Frame Trestle.....	W. A. McGonagle, J. H. Markley, Geo. C. Nutting, John Copeland.	
5.		
The Best Scale Foundation.....	O. J. Travis, Joseph Doll, C. E. Wadley, T. M. Strain.	

FOURTH CONVENTION, KANSAS CITY, MO., OCT. 16, 17, AND 18, 1894.

1.		
Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges.....	G. W. Andrews, W. G. Berg, J. E. Greiner, E. H. R. Green.	
2.		
Methods and Special Appliances for Building Temporary Trestles over Washouts and Burnouts.....	R. M. Peck, G. J. Bishop, A. B. Manning, C. D. Bradley.	
3.		
Strength of Various Kinds of Timber Used in Trestles and Bridges, Especially with Reference to Southern Yellow Pine, White Pine, Fir, and Oak...	W. G. Berg, J. H. Cummin, John Foreman, H. L. Fry.	

4.		
Best Method of Erecting Plate-Girder Bridges	...	H. M. Hall, J. M. Staten, G. W. Hinman, J. N. Pullen.
5.		
Best and Most Economical Railway Track Pile-Driver	...	J. L. White, A. C. Davis, J. F. Mock, James T. Carpenter.
6.		
Sand Dryers, Elevators, and Methods of Supplying Sand to Engines, including Buildings	...	Aaron S. Markley, H. A. Hanson, A. J. Kelley, J. O. Thorn.
7.		
Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate-Girders and Lattice-Bridges for Spans from 50 to 110 feet	...	W. A. McGonagle, R. M. Peck, W. M. Noon, H. E. Gettys.
8.		
Best Method of Spanning Openings too Large for Box Culverts, and in Embankments too Low for Arch Culverts	...	James Stannard, L. K. Spafford, O. H. Andrews, F. W. Tanner.
9.		
Best End Construction for Trestle Adjoining Embankments	...	G. M. Reid, J. L. Soisson, N. M. Markley, R. J. Howell.
10.		
Interlocking Signals	...	J. H. Travis, W. S. Danes, R. L. Heflin, J. A. Spangler.
11.		
Pumps and Boilers	...	John H. Markley, O. J. Travis, A. Shane, G. W. Markley.

FIFTH CONVENTION, NEW ORLEANS, LA., OCTOBER 15 AND 16, 1895.

1.		
How to Determine Size and Capacity of Openings for Waterways	...	Aaron S. Markley, J. S. Berry, C. C. Mallard, J. L. White.
2.		
Different Methods of Numbering Bridges. Should All Waterways be Numbered?	...	A. Shane, W. O. Eggleston, J. L. Slosson, O. J. Travis.
3.		
Drawbridge Ends, Methods of Locking; and under this head include Locking of Turn-tables	...	H. M. Hall, James Stannard, H. Middaugh, C. C. Mallard.
4.		
Protection of Trestles from Fire, including Methods of Construction	...	R. M. Peck, T. H. Kelleher, A. McNab, W. M. Noon, G. W. Hinman, William Berry.
5.		
Local Stations for Small Towns and Villages, giving Plans of Buildings and Platforms	...	J. H. Cummin, N. M. Markley, J. H. Markley, C. G. Worden.
6.		
Tanks, Size, Style, and Details of Construction, including Frost-proof protection to Tank and Pipes	..	W. O. Eggleston, W. M. Noon, A. McNab, N. W. Thompson.

7.

Shearing of Rivets in Plate-Girders and Cause Thereof	J. M. Staten, R. L. Heflin, J. H. Travis, G. M. Reid.

8.

Best and Uniform System of Report Blanks for Bridge and Building Department	G. J. Bishop, W. O. Eggleston, Onward Bates, M. Riney.

9.

Protection of Railroad Structures and Buildings from Fire	R. M. Peck, L. K. Spafford, B. T. McIver.

10. Brought forward from 1894.

Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges	G. W. Andrews, W. G. Berg, J. E. Greiner, E. H. R. Green.

11. Brought forward from 1894.

Best and Most Economical Railway Track Pile-Driver	J. L. White, A. C. Davis, J. F. Mock, J. T. Carpenter, G. W. Hinman.

12. Brought forward from 1894.

Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate-Girders and Lattice Bridges for Spans from 50 to 110 feet	W. A. McGonagle R. M. Peck, W. M. Noon, H. E. Gettys, G. J. Bishop, Onward Bates.

13. Brought forward from 1894.

Interlocking Signals	J. H. Travis, W. S. Danes, R. L. Heflin, J. A. Spangler.

SIXTH CONVENTION, CHICAGO, ILL., OCTOBER 20, 21, AND 22, 1896.

1.

Methods of Heating Buildings where Three or More Stoves are Now Used	J. H. Cummin, George W. Hinman, George W. Markley, Wm. Berry.

2.

The Most Suitable Material for Roofs of Buildings of All Kinds	R. M. Peck, G. W. Turner, W. M. Noon, N. W. Thompson.

3.

Roundhouse Construction, including Smoke-jacks and Ventilators	Geo. W. Andrews, O. J. Travis, W. O. Eggleston, James T. Carpenter.

4.

Care of Iron Bridges after Erection	James H. Travis, T. M. Strain, H. M. Hall, Walter Rogers.

5.

How to Determine Size and Capacity of Openings for Waterways	Walter G. Berg, Aaron S. Markley, Onward Bates, A. J. Kelley.

6.		
Protection of Railroad Buildings and Other Structures from Fire	W. A. McGonagle, M. M. Garvey, J. D. Hilderbrand, John Foreman.	
7.		
Designs for Ice-Houses	W. B. Yeraance, C. M. Large, J. H. Markley, Geo. W. Ryan.	
8.		
Best End Construction for Trestles adjoining Embankments	C. C. Mallard, W. S. Danes, R. L. Heflin, A. C. Olney.	
9.		
Bridge Warnings for Low Overhead Structures	W. E. Harwig, M. A. Martin, E. H. R. Green, Joseph Doll.	
10.		
Stock-yards and Stock-sheds, including all Details of Construction	Geo. J. Bishop, W. R. Cannon, O. H. Andrews, James Brady.	
11.		
Floor System on Bridges, including Skew Bridges	W. G. Guppy, C. P. Austin, C. W. Gooch, F. W. Tanner.	

SEVENTH CONVENTION, DENVER, COL., OCTOBER 19, 20, AND 21, 1897.

1.		
ile-rings and Method of Protecting Pileheads in Driving	G. W. Hinman, Wm. S. Danes, F. Eilers, E. F. Reynolds, Wm. Carmichael, C. M. Large.	
2.		
Cost and Manner of Putting In Pipe Culverts	Walter A. Rogers, Frank W. Tanner, John H. Markley, A. H. King, B. F. Bond, O. H. Andrews.	
3.		
Best Floors for Shops and Roundhouses	A. W. Merrick, C. S. Thompson, Wm. O. Eggleston, M. F. Cahill, J. B. Pullen, James Gilbert.	
4.		
Roundhouse Smoke-jacks and Ventilation	George W. Andrews, Wm. O. Eggleston, Aaron S. Markley, R. J. Howell, J. T. Carpenter, A. McNab.	
5.		
Cattleguards and Wingfences	C. C. Mallard, C. S. Thompson, A. Zimmerman, L. H. Wheaton, O. W. Osborne, R. L. Heflin.	
6.		
Prevention of Fire in Railroad Buildings	John D. Isaacs, Wm. A. McGonagle, M. Riney, H. L. Fry, J. P. Snow, Wm. B. Yearance.	

7.

Storage of Fuel, Oil, and Other Station Supplies at Way-stations	Arthur Montzheimer, A. Shane, G. E. Hanks, J. E. Johnson, W. Z. Taylor, E. M. Gilchrist.

8.

Railroad Highway Crossing Gates	Joseph H. Cummin. J. B. Sheldon, Wm. E. Harwig, G. W. Smith, J. E. Featherston, W. M. Noon.

9.

What Repairs, and How Can they be Safely Made, to Metal and Wooden Spans Without the Use of False-work	F. S. Edinger, B. W. Guppy, J. E. Greiner, John D. Isaacs, Walter A. Rogers, H. W. Fletcher.

10.

Care of Iron Bridges After Erection, including Best Method of Protecting Them From Injury by Salt Water Drippings from Refrigerator cars	J. E. Greiner, B. W. Guppy, James McIntyre, T. M. Strain, A. J. Kelley, L. F. Goodale.

11.

Turntable Construction	Onward Bates, J. B. Sheldon, D. K. Colburn, John Foreman, E. Fisher, Henry Goldmark.

EIGHTH CONVENTION, RICHMOND, VA., OCTOBER 18 AND 19, 1898.

1.

What is the Most Economical Method of Painting Railway Bridges and Buildings, and Best Material to use	A. Montzheimer, B. F. Pickering, H. D. Cleaveland, W. A. McGonagle.

2.

Life of Different Kinds of Timber in Bridges of Various Kinds, and Advisability of Protecting Same from the Weather	B. W. Guppy.

3.

The Best Method of Constructing and Maintaining Highway and Farm Crossings	J. H. Markley, W. O. Eggleston, T. M. Strain, O. J. Travis.

4.

Best Practical Sanitary Arrangement for Local Stations where there are no Water or Sewer Systems.	W. A. Rogers, J. B. Sheldon, C. H. Miller, J. McIntyre.

5.

Best and Most Economical Plant for Pumping Water for Water Stations	A. Shane, A. S. Markley, R. L. Heflin, W. E. Smith.

6.

Necessary and Kind of Tools for the Proper Equipment of a Gang of Bridge Men	G. J. Bishop, G. W. Hinman, M. Riney, A. Zimmerman.

7.

Best Snow Fence—Stationary and Portable	A. W. Merick, A. E. Killam, J. D. Isaacs. A. H. King.

8. Brought forward from 1897.

What Repairs and How Can They Be Safely Made to Metal and Wood Spans Without the Use of False Work	F. S. Edinger, J. E. Greiner, J. D. Isaacs, W. A. Rogers, H. W. Fletcher.

9. Brought forward from 1897.

Prevention of Fire in Railroad Buildings	G. W. Andrews, A. D. Schindler, W. E. Smith, S. B. Rice.

NINTH CONVENTION, DETROIT, MICH., OCTOBER 17 AND 18, 1899.

1. Brought forward from 1898.

Necessary and Kind of Tools for the Equipment of a Gang of Bridge Men	W. S. Danes, J. M. Staten, W. O. Eggleston, J. M. Caldwell.

2. Brought forward from 1898.

Best Snow Fence, Stationary or Portable	W. E. Smith, A. McNab, Geo. E. Hanks, A. W. Merrick. W. M. Noon.

3.

Best Method of Erecting Track Scales, Suspended or under Track	H. D. Cleveland, Wm. M. Clark, C. P. Austin, J. T. McIlwaine.

4.

Is Concrete the Most Suitable and Economical Material for Bridge Piers and Abutments and Railway Culverts and Arches?	W. A. Rogers.

5.

Hand *vs.* Air-riveting Power Used. Actual Cost Compared with Hand Work in the Field for the Erection of New Work and Repairing; also Drilling for Reinforcing old Spans	A. B. Manning, A. Shane, Geo. J Bishop, O. J. Travis, F. W. Tanner, F. S. Edinger.

6.

Most Practical and Cheapest Bumper for Yard Terminals	B. F. Pickering, A. A. Page, W. E. Harwig, A. E. Killam.

7.

Are Tie Plates on Bridge Ties a Benefit or a Detriment?	C. A. Lichty, A. Montzheimer, C. W. Vandergrift, H. W. Fletcher, F. S. Edinger, J. B. Sheldon.

TENTH CONVENTION, ST. LOUIS, MO., OCT. 16, 17, AND 18, 1900.

1.

Methods of Sinking Foundations for Bridge Piers in Depth of Water Twenty Feet and Under.....	G. W. Andrews, C. C. Mallard, C. A. Lichty, C. W. Gooch, C. S. Thompson, D. Robertson.

2.

Passenger Platforms at Way Stations, Best Material and Cost of Same.....	J. B. Sheldon, John I. Banks, N. H. La Fountain, L. H. Wheaton, Wm. A. Fort, A. McNab.

3.

Slips for Ferry Boats Used for Transferring Railway Cars.....	John D. Isaacs, H. D. Cleaveland, J. H. Cummin, Charles Carr, H. Rettinghouse, J. T. Carpenter.

4.

Best Method of Operating Turn-tables by Power....	F. E. Schall, J. E. Greiner, B. F. Pickering, Onward Bates.

5.

Auxiliary Coaling Stations; Best Design, Capacity, and Method of Handling Coal.....	W. A. McGonagle, G. W. Smith E. Fisher, J. P. Snow, B. F. Bond, R. B. Tweedy.

6.

Water Stations; Best Material for Foundations, Tanks, Substructure, Connections, Capacity, etc...	A. S. Markley, Charles Carr, W. O. Eggleston, A. J. Austin A. Shane.

7.

Is it Best for Railroad Companies to Erect Their Own Steel Structures, or Let the Manufacturers Erect Them?.....	O. J. Travis, F. S. Edinger, A. B. Manning, James McIntyre, A. Zimmerman.

8.

The Best and Most Convenient Outfit Cars for Bridge Gangs, and Number of Men Constituting a Bridge Gang.....	A. W. Merrick, S. S. Millener, Wm. M. Clark, A. A. Page, M. F. Cahill, W. E. Harwig, G. O. Lilly.

1.

Auxiliary Coaling Stations; Best Designs, Capacity, and Method of Handling Coal. Brought forward from 1900	W. A. McGonagle, G. W. Smith, E. Fisher, J. P. Snow, B. F. Bond, R. B. Tweedy.

2.

Roof Coverings, First Cost, Life, Efficiency, and Maintenance Expenses for Various Classes of Railroad Buildings	E. Fisher, R. H. Reed, J. S. Berry, J. P. Snow.

3.

Mail Cranes, First Cost, Efficiency and Maintenance of Various Styles in Use	A. S. Markley, F. Price, James Brady, G. W. Smith, D. W. Lum.

4.

Best Method of Protecting Low Overhead Structures Over Tracks from Gases and Blast of Locomotives.	G. W. Andrews, J. S. Lemond, C. M. Large, A. H. King, James T. Carpenter, E. H. R. Green, A. E. Killam.

5.

What has been the Expenses in the Use of Concrete Under Bridge Bedplates and Turn-tables in Place of Pedestal Stones, and What is the Best Form and Material for Bedplates Under Various Styles of Iron Bridges?	W. A. Rogers, Frank W. Tanner, George J. Bishop, J. H. Markley, A. McNab, George E. Hanks.

6.

Best Design and Recent Practice in Building Railroad Track Pile Driver	T. M. Strain, A. W. Merrick, Chas. C. Mallard, A. B. Manning, W. M. Noon, W. T. Powell.

7.

Best Material and Designs for Roundhouse Pits, Including Drainage and Rail Fastings	ArthurMontzheimer, E. M. Gilchrist, J. W. Taylor, James Stannard, Onward Bates.

8.

Best Materials for Wearing Surface of Roadway of Highway Bridge Floors	W. O. Eggleston, B. F. Peckering, A. B. Sheldon, C. P. Austin, Joseph M. Staten, O. J. Travis.

1.

Best False Work for Rocky Bottom in Rapid Currents Where Piles Cannot be Driven.....	John P. Canty, H. H. Eggleston, O. D. Killebrew, F. F. Lloyd, A. C. Macy, J. E. Greiner.

2.

Should Ties of Bridges be Gained so as to Leave Rail Without Camber, or Should Only a Portion of Camber Be Taken Out?.....	R. H. Reid, Onward Bates, H. D. Cleaveland, Henry Goldmark, J. E. Johnson, G. W. McGehee.

3.

In Case One Arm of an Important Metal Drawbridge Over a Deep Stream Should be Wrecked, What is the Most Expeditious Way to Restore Railway and Water Traffic?.....	John D. Isaacs, F. E. Schall, Geo. C. Nutting, W. M. Noon, A. McNab, Geo. W. Andrews.

4.

What is the Best Form of Traveler to Use in Erecting Steel Railway Bridges of Spans up to Two Hundred Feet?.....	G. W. Smith, O. J. Travis, J. P. Snow, C. W. Kelley, Joseph M. Staten, F. W. Tanner.

5

Best Method of Protecting Solid Steel Floors of Bridges.....	A. O. Cunningham, Geo. F. Powers, D. W. Lum, Albert C. Keith, C. P. Austin, F. E. Schall.

6.

Best Plans for Small Tool Houses, Including Switchmen's and Car Repairers' Shanties, and Section, Tool, and Hand-car Houses.....	J. B. Sheldon, H. E. Holmes, W. E. Bell, Geo. Mitchell, Ed. Gagnon, C. R. Walton.

7.

Best Practical Sanitary Arrangements for Small Stations Where There Are no Water or Sewer Systems	J. H. Markley, F. J. Leavitt, Geo. J. Patterson, E. B. Ashby, T. J. Darracott, A. W. Merrick.

8.

Best Method of Making Annual Inspection of Bridges and Culverts, and Form of Report to be Made.....	Walter G. Berg, J. A. Dodson, C. F. Loweth, Arthur Montzheimer, A. Zimmerman, A. Shane. I. O. Walker.

9.

Water Filters, or Other Methods of Purifying Water for Engine Use.....	R. C. Sattley, J. E. Greiner, Ed. M. Gilchrist, Geo. E. Hanks, A. B. Manning, James Rogers.

10.

Best Method of Storing Fuel Oil, With Appliances for Supplying Locomotives, Including Plan of Water Stations, Showing Relative Arrangements of Fuel and Water Supply.....	C. C. Mallard, J. S. Berry, Geo. J. Bishop, William Carmichael, W. M. Clark, I. W. Evans, E. Fisher.

11.

What Has Been the Experience in the Use of Concrete Under Bridge Bed-plates and Turn-tables in Place of Pedestal Stones, and What is the Best Form and Material for Bed-plates Under Various Styles of Iron Bridges.....	Walter A. Rogers, A. Minster, L. F. Goodale, E. H. R. Green, J. C. Hain, E. P. Hawkins.

THIRTEENTH CONVENTION, QUEBEC, CANADA, OCT. 20 TO 22, 1903.

1.

What is the Best Form of Traveler to Use in Erecting Steel Railway Bridges of Spans up to 200 Feet..	G. W. Smith, Moses Burpee, Geo. J. Bishop, A. O. Cunningham, J. C. Hain, J. F. Stern.

2.

What Has Been the Experience in Use of Concrete Under Bridge Bed-plates and Turn-tables in Place of Pedestal Stones, and What is the Best Form and Material for Bed-plates Under Various Styles of Iron Bridges (Continued from 1902).....	C. F. Loweth, T. M. Strain, J. E. Johnson, A. Minster, D. W. Lum, J. P. Snow.

3.

Best Methods of Caring for Trestles While Being Filled.....	A. H. King, J. B. Sheldon, H. D. Cleaveland, A. J. Hart, F. Ingalls, J. S. Lemond.

4.

Best Forms of Construction for Engine Houses.	A. W. Merrick, L. H. Wheaton, R. L. Heflin, C. W. Kelley, C. C. Mallard, A. B. Manning.

5.

Best Methods of Filling Ice Houses and Conveying Ice to Refrigerator Cars.....	J. T. Carpenter, F. L. Burrell, John P. Canty, A. McNab, C. M. Large, G. Larson.

6.

Best Methods of Filling Track Water Tanks Automatically.....	E. B. Ashby, Willard Beaham, C. H. Miller, Thomas S. Leake, F. E. Schall, L. F. Price.

7.

Steam Hammers Versus Drop Hammers for Pile-drivers	O. J. Travis, R. H. Reid, N. H. LaFountai Frank J. Leavitt, G. O. Lilly, H. Rettinghouse.

8.

Best Form of Construction for Docks and Wharves	John D. Isaacs, W. A. McGonagle, Henry Goldmark, G. J. Klump, R. B. Tweedy, G. F. Powers.

9.

Best Record Forms for Buildings, Water Tanks, etc.	B. J. Sweatt, B. F. Pickering, A. Shane, I. O. Walker, J. F. White, William E. Harwig.

10.

Best Freight and Roundhouse Doors, and Fittings for the Same	John I. Banks, James McIntyre, R. K. Ross, Ed. Gilchrist, George W. Welker.

11.

Best Methods for Preserving Timber and Piles in Structures	Wm. F. Steffen, John D. Isaacs, Geo. A. Mountain, E. Loughery, C. C. Witt, B. F. Bond.

12.

Best Methods of Protecting Low Overhead Structures Over Tracks from Gases and Blast of Locomotives	B. W. Guppy, Grosvenor Aldrich, F. F. Lloyd, Robert J. Bruce, Wm. M. Clark, J. S. Berry.

CONSTITUTION.

ARTICLE I.

NAME.

SECTION 1. This Association is known as the "Association of Railway Superintendents of Bridges and Buildings."

ARTICLE II.

OBJECT.

SECTION 1. The object of this Association shall be the mutual advancement of its members, by the acquirement of more perfect knowledge in the construction, maintenance, and repair of railroad bridges and buildings, as well as all other matters entrusted to the care of superintendents of bridges and buildings, by common discussion, interchange of ideas, reports, and investigations of its members.

ARTICLE III.

MEMBERSHIP.

SECTION 1. Any person at the head of a bridge and building department on any railroad, or a division or subdivision, and to include assistant superintendent and general foreman of any railroad, shall be eligible to membership in this Association upon application to the Secretary and the payment of $3.00 membership fee and $2.00 for one year's dues, membership to continue until written resignation is received by the Secretary, unless member has been previously expelled.

SEC. 2. Any member guilty of dishonorable conduct, or conduct unbecoming a railroad official and member of this Association, or who shall refuse to obey the chairman, or rules of this Association, may be expelled by a two-thirds vote of the members present.

SEC. 3. Any member elected a Life Member of this Association, shall have all of the privileges of an active member, but shall not be required to pay annual dues.

ARTICLE IV.

OFFICERS.

SECTION 1. The officers of this Association shall be a president, four vice-presidents, a secretary, a treasurer, and six executive members. The executive members, together with the president, secretary, and treasurer, shall constitute the Executive Committee.

All Past-Presidents of this Association, who continue to be members, shall be entitled to be present at all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions coming before the Executive Committee and to aid said committee by their advice and counsel; but, said Past-Presidents shall not have a right to vote, nor shall their presence be requisite in order to constitute a quorum.

ARTICLE V.

DUTIES OF OFFICERS.

SECTION 1. The duties of officers shall be such as prescribed by by-laws, as pertain to officers of like character, general, or may be assigned them by the Executive Committee.

ARTICLE VI.

EXECUTIVE COMMITTEE.

SECTION 1. The Executive Committee shall exercise a general supervision over the financial and other interests of the Association, assess the amount of annual and other dues, call, prepare for, and conduct general or special meetings, make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have power to render the Association liable for any debt beyond the amount then in the treasurer's hands not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

SEC. 2. The Executive Committee shall report the proceedings of its meetings, making such reports accessible to members; it shall publish the proceedings of all meetings of the Association, subject to the approval of the Association.

SEC. 3. Two thirds of the members of the Executive Committee may call special meetings, sixty days' notice being given members by mail.

SEC. 4. Five members of the Executive Committee shall constitute a quorum for the transaction of business.

ARTICLE VII.

ELECTION OF OFFICERS AND TENURE OF OFFICE.

SECTION 1. The officers, excepting as otherwise provided, shall be elected at the regular meeting of the Association, held on third Tuesday in October of each year, and the election shall not be postponed except by unanimous consent.

PRESIDENT AND TREASURER.

SEC. 2. The president and treasurer shall be elected by ballot by a majority of votes cast, and shall hold office for one year, or until successors are elected.

VICE-PRESIDENTS AND EXECUTIVE MEMBERS.

SEC. 3. The vice-presidents shall hold office for one year and executive members for two years, four vice-presidents, and three executive members to be elected each year; provided, however, that three of the executive members be appointed by the president at the adoption of this constitution. All officers herein named to hold office until successors are chosen at next annual meeting.

SEC. 4. In the election of vice-presidents, each one shall be elected by a majority vote. Executive members will be elected in the same way, all voting to be by written ballots.

SECRETARY.

SEC. 5. A secretary shall be elected by a majority of the votes of the members present at the annual meeting. The term of office of the secretary shall be for one year, unless terminated sooner by action of the Executive Committee, two-thirds of whom may remove the secretary at any time. His compensation shall be fixed by a majority of the Executive Committee. The secretary shall also be secretary of the Executive Committee.

TREASURER.

SEC. 6. The treasurer shall be required to give bond in an amount to be fixed by the majority of the Executive Committee.

ARTICLE VIII.

COMMITTEES.

SECTION 1. At the first session of the annual meeting the president shall appoint a committee of three members, not then officers of the Association, who shall send names of nominees for officers of the Association for the ensuing year to the secretary, before the election of officers is in order, and the names shall be announced as soon as received. The election shall not be held until the day after announcement, except by unanimous consent. Nothing in this section shall be construed to prevent any members from making nominations.

AUDITING COMMITTEE.

SEC. 2. At the first session of each annual meeting there shall be appointed by the president an auditing committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the treasurer and certify as to the correctness of his accounts. Acceptance of this committee's report will be regarded as the discharge of the committee.

COMMITTEES ON SUBJECTS FOR DISCUSSION.

SEC. 3. At the annual meeting there shall be appointed by the president a committee, whose duty it shall be to prepare and report subjects for discussion and investigation at the next annual meeting. If subjects are approved by the Association, the president shall appoint a committee to report on them. It shall be the duty of the committee to receive from members questions for discussion during the time set apart for that purpose. This committee shall be the judge of whether such questions are suitable ones for discussion, and if so, report them to the Association.

COMMITTEES ON INVESTIGATION.

SEC. 4. When the committee on subjects has reported and the Association approved of the same, the president shall appoint special committees to investigate and report on said subjects and he may appoint a special committee to investigate and report on any subject which a majority of members present may approve of.

ARTICLE IX.

ANNUAL DUES.

SECTION 1. Every member shall pay to the treasurer three dollars membership fee, and shall also pay two dollars per year in advance to defray the necessary expenses of the Association. No member being one year in arrears for dues will be entitled to vote at any election, and any member one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

ARTICLE X.

AMENDMENTS.

SECTION 1. This constitution may be amended at any regular meeting by a two-thirds vote of members present, provided that a written notice of the proposed amendment has been given at least ninety days previous to said regular meeting.

BY-LAWS.

TIME OF MEETING.

1. The regular meeting of this Association shall be held annually on the third Tuesday in October.

HOUR OF MEETING.

2. The regular hour of meeting shall be at 10 o'clock a. m.

PLACE OF MEETING.

3. The cities or places for holding the annual convention may be proposed at any regular meeting of the Association before the final adjournment. The places proposed shall be submitted to a ballot vote of the members of the Association, the city or place receiving a majority of all the votes cast to be declared the place of the next annual meeting; but if no place received a majority of all votes, then the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

QUORUM.

4. At the regular meeting of the Association, fifteen or more members shall constitute a quorum.

ORDER OF BUSINESS.

5. 1st—Calling of roll.
   2d—Reading minutes of last meeting.
   3d—Admission of new members.

4th—President's address.
5th—Reports of secretary and treasurer.
6th—Payment of annual dues.
7th—Appointment of committees.
8th—Reports of committees.
9th—Unfinished business.
10th—New business.
11th—Reading and discussion of questions propounded by members.
12th—Miscellaneous business.
13th—Election of officers.
14th—Adjournment.

DUTIES OF OFFICERS.

6. It shall be the duty of the president to call the meeting to order at the appointed time; to preside at all meetings; to announce the business before the Association, and to decide all questions of order and sign all orders drawn on the treasurer.

7. It shall be the duty of the vice-presidents, in the absence of the president, to preside at all meetings of the Association, in their order named.

8. It shall be the duty of the secretary to keep a correct record of proceedings of all meetings of this Association; to keep correct all accounts between this Association and its members; collect all moneys due the Association, and pay the same over to the treasurer and take his receipt therefor, and to perform such other duties as the Association may require.

9. It shall be the duty of the treasurer to receive and receipt to the secretary for all moneys received from him, and pay all orders authorized by the Association.

DECISIONS.

10. The votes of a majority of members present shall decide any question, motion, or resolution which shall be brought before the Association, unless otherwise provided.

DISCUSSIONS.

11. All discussions shall be governed by Roberts' Rules of Order.

DIRECTORY OF MEMBERS.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

OCTOBER, 1903.

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WELKER, GEORGE W., Southern Ry., Alexandria, Va.

WHEATON, L. H., The Coast Railway of Nova Scotia, Yarmouth, N. S.

WHITE, J. F., C., H. & D. Ry., Hamilton, Ohio.

WHITE, I. H., Chief Engineer, H. & S. W. Ry., Bridgewater, N. S.

WILKINSON, JOHN M., Cin. Northern R. R., 702 N. Washington St., Van Wert, Ohio.

WILKINSON, W. H., Erie R. R., Elmira, N. Y.

WITT, C. C., C. & N. W. Ry., Chicago, Ill.

WISE, E. F., Ill. Central Ry., Waterloo, Ia.

WOODARD, W. R., Southern Ry., Asheville, N. C.

Y

YAGER, LOUIS, Nor. Pac. Ry., Minneapolis, Minn.

YAPPEN, ADOLPH, C., M. & St. P. Ry., Milwaukee, Wis.

YEREANCE, WM. B., South Orange, N. J.

Z

ZIMMERMAN, A., Denver, Col.

ZOOK, D. C., Penn. Lines West of Pittsburg, Ft. Wayne, Ind.

LIFE MEMBERS.

CRANE, HENRY, C. & N. W. Ry., Janesville, Wis.

FLETCHER, HOLLAND W., 2376 California Ave., Alleghany, Pa.

FOREMAN, JOHN, Phil. & Read. R. R., Pottstown Pa.

WALDEN, W. D., C. & N. W. Ry., Clinton, Ia.

DECEASED MEMBERS.

DEMARS, JAMES, Wheeling & L. Erie R. R., Norwalk, Ohio.

DUNLAP, H., Wabash R. R., Andrews, Ind.

FULLER, C. E., T. H. & I. R. R., Terre Haute, Ind.

GRAHAM, T. B., Nor. Pac. Ry., Little Falls, Minn.

HINMAN, G. W., Louisville & Nashville R. R., Evansville, Ind.

ISADELL, L. S., O. & M. R., Lawrenceburgh, Ind.

LOVETT, J. W., Southern Ry., Atlanta, Ga.

MARKLEY, ABEL S., Pittsburg & Western, Ry. Co., Alleghany, Pa.

MITCHELL, J. B., C., C., C. & St. L. Ry., Indianapolis, Ind.

MITCHELL, W. B., N. Y., P. & O. R. R., Gallion, Ohio.

PECK, R. M., Missouri Pac. & St. L., I. M. & S. Ry., Pacific, Mo.

REID, GEORGE M., L. S. & M. S. R. R., Cleveland, Ohio.

SPAFFORD, L. K., K. City, Fort Scott & Memphis Ry., Kansas City, Mo.

THOMPSON, N. W., P., F. W. & C. Ry., Ft. Wayne, Ind.

TOZZER, WILLIAM S., C. & O. R. R., Cincinnati, Ohio.

TRAUTMAN, J. J., S. C. R. R., Edgefield, S. C.

WORDEN, C. G., S. F. Pac. R. R., Winslow, Ariz.

MEMBERSHIP AND MILEAGE OF RAILWAYS REPRESENTED IN THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

Name of Road and Membership.	Members.	Mileage.
Atlantic & West Point Railway and W. Railway of Alabama	1	225
Nelson, O. T., Montgomery, Ala.		
Atchison, Topeka & Santa Fé Railway	2	4,914
Gilbert, James D., Topeka, Kan.		
Parker, J. F., San Bernardino, Cal.		
Atlantic Coast Line (Plant System) Railroad	5	4,058
Bell, W. E., Thomasville, Ga.		
Cooper, A. R., Montgomery, Ala.		
Darracot, T. J., Lakeland, Ga.		
Newton, J. B., Ridgeland, S. C.		
Price, L. F., Waycross, Ga.		
A., T. & S. F. Company, Coast Lines	2	1,305
Shope, D. A., Winslow, Ariz.		
Schindler, A. D., Stockton, Cal.		
Baltimore & Ohio Railroad	4	3,430
Andrews, George W., Baltimore, Md.		
Clark, William M., Warren, Ohio.		
Greiner, J. E., Baltimore, Md.		
McIlwaine, J. T., Akron, Ohio.		
Bangor & Aroostook Railroad	2	413
Alexander, W. E., Houlton, Me.		
Burpee, Moses, Houlton, Me.		
Bessemer & Lake Erie Railroad	1	220
Cleaveland, H. D., Greenville, Pa.		
Boston & Maine Railroad	11	2,282
Austin, Cyrus P., Medford, Mass.		
Battey, C. C., Springfield, Mass.		
Canty, John P., Fitchburg, Mass.		
Leavitt, F. J., Sanbornville, N. H.		
Lydston, William A., Salem, Mass.		
Mountfort, Albert, Nashua, N. H.		
Page, Adna A., Boston, Mass.		
Patterson, Samuel F., Concord, N. H.		
Pickering, B. F., Sanbornville, N. H.		
Snow, J. P., Boston, Mass.		
Spaulding, E. C., St. Johnsbury, Vt.		

Barclay Railroad	1	
Davis, Charles Henry, New York City.		
Central Indiana Railway	1	128
Eggleston, H. H., Anderson, Ind.		
Chicago & Erie Railroad	1	269
McLean, Neil, Huntington, Ind.		
Chicago, Milwaukee & St. Paul Railway	6	6,553
Hart, A. J., Minneapolis, Minn.		
Hain, J. C., Chicago, Ill.		
Loweth, C. F., Chicago, Ill.		
LaFountain, N. H., Marion, Ia.		
Yappen, Adolph, Milwaukee, Wis.		
Smith, W. E., Chicago, Ill.		
Chesapeake & Nashville Railroad	1	48
Henson, H. M., Gallatin, Tenn.		
Canada Atlantic Railway	1	468.4
Mountain, George A., Ottawa, Can.		
Chicago, Burlington & Quincy Railway	1	2,675
Thorn, J. O., Beardstown, Ill.		
Chicago, Burlington & Kansas City Railway	1	220
Gilchrist, Ed. M., Centerville, Ia.		
Choctaw, Oklahoma & Gulf Railroad	1	1,053
Pool, J. R., Little Rock, Ark.		
Central of Georgia Railway	1	1,845
Tucker, M. F., Americus, Ga.		
Cincinnati, Hamilton & Dayton Railway	2	910
White, J. F., Hamilton, Ohio.		
Anderson, J. W., Chillicothe, Ohio.		
Chicago, Indiana & Louisville Railroad	1	537.11
Caldwell, J. M., Lafayette, Ind.		
Chicago & Eastern Illinois Railroad	2	737.5
Dawley, W. S., Chicago, Ill.		
Markley, Aaron S., Danville, Ill.		
Chicago Great Western Railway	5	1,321
Desiletes, L. P., Des Moines, Ia.		
Macy, Elbert C., St. Paul, Minn.		
Minster, A., St. Paul, Minn.		

The Coast Railway of Nova Scotia	1	
Wheaton, L. H., Yarmouth, N. S.		
Chicago & North Western Railway	21	5,759.61
Anderson, L. J., Escanaba, Mich.		
Beahan, Willard, Winona, Minn.		
Burrell, F. L., Fremont, Neb.		
Crane, Henry, Janesville, Wis. (life member).		
Fletcher, H. W., Alleghany, Pa. (life member).		
Kelly, C. W., Boone, Ia.		
Halsey, W. C., Eagle Grove, Ia.		
Lichty, C. A., Fond du Lac, Wis.		
Loughnane, George, Mason City, Ia.		
Merrick, A. W., Eagle Grove, Ia.		
Morrill, H. P., Madison, Wis.		
Rettinghouse, H., Kaukauna, Wis.		
Reynolds, Edward F., Antigo, Wis.		
Riney, M., Baraboo, Wis.		
Sattley, R. C., Chicago, Ill.		
Stern, I. F., Chicago, Ill.		
Sweatt, B. J., Mason City, Ia.		
Walden, W. D., Clinton, Ia.		
Walden, H. A., Boone, Ia.		
Witt, C. C., Chicago, Ill.		
Trippe, H. M., Chicago, Ill.		
Chicago, Rock Island & Pacific Railway	2	5,494.7
Brady, James, Davenport, Ia.		
Park, F. L., Topeka, Kan.		
Chesapeake & Ohio Railway	3	1,620
Garrison, I., Richmond, Va.		
Staten, Joseph M., Richmond, Va.		
Vandergrift, C. W., Alderson, W. Va.		
Canadian Pacific Railway	4	8,190
Goldmark, Henry, Montreal, P. Q.		
Gutelius, F. P., Montreal, P. Q.		
Monsarrat, C. N., Montreal, P. Q.		
Tye, W. F., Montreal, P. Q.		
C., C., C. & St. L. Railway (Big Four)	1	2,345
Miller, C. H., Cleveland, Ohio.		
Colorado & Southern Railway	2	
Powell, W. T., Denver, Col.		
Travis, O. J., Denver, Col.		
Cincinnati Northern Railroad	1	245
Wilkinson, John M., Van Wert, Ohio.		

Central Vermont Railroad	3	495
Flint, C. F., St. Albans, Vt.		
Holmes, H. E., New London, Conn.		
Patterson, George J., Waterbury, Vt.		
Duluth, South Shore & Atlantic Railway	1	579
Noon, W. M., Marquette, Mich.		
Duluth, Missabe & Northern Railway	1	153
McGonagle, W. A., Duluth, Minn.		
Chicago, L. S. & Eastern & E. J. & E. Ry	3	366
Montzheimer, A., Joliet, Ill.		
Powers, George F., Joliet, Ill.		
Short, M. D., Joliet, Ill.		
Chicago, St. P., M. & O. Railway	3	1,557
Larson, G. C., Spooner, Wis.		
McCormack, J. W., Altoona, Wis.		
Schwartz, John, Emerson, Neb.		
Erie Railroad	3	2,154
Eggleston, William O., Galion, Ohio.		
McIntyre, James, Cleveland, Ohio.		
Wilkinson, W. H., Elmira, N. Y.		
Erie & Pittsburg Railway	1	
Large, C. M., Jamestown, Pa.		
Flint & Pere Marquette Railway	2	
Hawks, George E., East Saginaw, Mich.		
McNab, A., Holland, Mich.		
Gulf, Colorado & S. Fe	1	1,128
Smith, L. D., Cleburne, Tex.		
Grand Trunk Railway System	6	4,182
Bishop, George J., Durand, Mich.		
Brown, Ebenezer, Allandale, Ont.		
Ross, R. K., Ionia, Mich.		
Findley, A., Montreal, P. Q.		
Mitchell, George A., Toronto, Ont.		
Patton, A. E., Montreal, P. Q.		
Georgia Railroad	2	324
Guill, B. A., Camok, Ga.		
Robinson, W. M., Augusta, Ga.		
Halifax & South Western Railway	1	
White, I. H., Bridgewater, N. S.		
Hannibal & St. Joseph Railway	1	273
Goodale, L. F., St. Louis, Mo.		

Intercolonial Railway.	7	1,343
Burpee, T. C., Moncton, N. B.		
Jardine, Hugh, Moncton, N. B.		
Killam, A. E., Moncton, N. B.		
McGrath, H. I., Moncton, N. B.		
McKenzie, W. B., Moncton, N. B.		
Sefton, Thomas, Moncton, N. B.		
Selig, A. C., Moncton, N. B.		
Illinois Central Railroad.	6	4,265
Leake, Thomas S., Chicago, Ill.		
Lilly, G. O., Carbondale, Ill.		
McKee, R. J., Clinton, Ill.		
Reed, William, Jr., Chicago, Ill.		
Wagener, W. C., Central City, Ky.		
Wise, E. F., Waterloo, Iowa.		
Jacksonville & St. Louis Railway.	1	114
Bond, B. F., Jacksonville, Ill.		
Lake Erie & Western Railroad.	1	720
Penwell, John M., Tipton, Ind.		
Lehigh & Hudson River Ry.	1	90
Barrett, John E., Warwick, N. Y.		
Lake Shore & Michigan Southern.	1	1,416
R. H. Reid, Cleveland, Ohio.		
Lehigh Valley Railroad.	5	1,342
Ashby, E. B., So. Bethlehem, Pa.		
Berg, Walter G., New York City.		
Harwig, William E., Phillipsburg, N. J.		
Heflin, R. L., Sayre, Pa.		
Schall, Frederick E., So. Bethlehem, Pa.		
Long Island Railroad.	1	393
Cummin, Joseph H., Jamaica, N. Y.		
Louisville & Nashville Railroad.	1	3,529
Ingram, Floyd, Erin, Tenn.		
Missouri, Kansas & Texas Railway System.	2	2,460
Austin, A. J., St. Louis, Mo.		
Manning, A. B., Parsons, Kan.		
Mobile & Ohio Railroad.	2	876
Hawkins, E. P., Okolona, Miss.		
McGehee, G. W., Okolona, Miss.		
Maine Central Railroad.	2	824
Guppy, B. W., Portland, Me.		
Watson, P. N., Brunswick, Me.		

Michigan Central Railroad	2	1,662
Carr, Charles, Jackson, Mich.		
Horning, Henry A., Niles, Mich.		
Minneapolis, St. P. & S. Ste. M. Railway	2	1,470
Amos, Alexander, Minneapolis, Minn.		
Swenson, Peter, Minneapolis, Minn.		
Missouri Pacific Railway	2	5,326
Fisher, E., Pacific, Mo.		
Tanner, Frank W., Atchison, Kan.		
Mason City & Ft. Dodge Railroad	1	133
Keith, Herbert C., Fort Dodge, Ia.		
Minneapolis & St. Louis Railroad	1	642
Gagnon, Ed., Minneapolis, Minn.		
Nashville, Chattanooga & St. Louis Railroad	1	1,196
Walker, I. O., Paducah, Ky.		
New York, New Haven & Hartford Railroad	3	2,038
Aldrich, Grosvenor, Readville, Mass.		
Phillips, Henry W., So Braintree, Mass.		
Sheldon, J. B., Providence, R. I.		
Gulf, Colorado & Santa Fe Railway	1	1,128
Hull, K. S., Beaumont, Tex.		
New York, Chicago & St. Louis	1	523
Rogers, James, Ft. Wayne, Ind.		
New York Central & Hudson River Railroad	6	3,320
Banks, John I., New York City.		
Johnson, J. E., New York City.		
Klump, G. J., Rochester, N. Y.		
Thompson, H. C., Weehawken, N. J.		
Steffen, William F., New York City.		
Mills, R. P., 138th St., Mott Haven, N. Y.		
Northern Pacific Railway	3	5,036
Ingalls, F., Jamestown, N. D.		
Yager, Lewis, Minneapolis, Minn.		
McIvers, B. T., St. Paul, Minn.		
Oregon Short Line Railroad	1	1,689
King, A. H., Pocatello, Idaho.		
Pittsburg & Lake Erie Railroad	1	180
Soles, G. H., Pittsburg, Pa.		
P. & P. M. Railway	1	
Tippett, John B., Peoria, Ill.		

Portland & Rumford Falls Railroad	1	68
Osgood, Cleon S., Rumford Falls, Me.		
Penn. Lines West of Pittsburg	2	5,165
Miller, A. F., Chicago, Ill.		
Zook, D. C., Ft. Wayne, Ind.		
Philadelphia & Reading Railroad	1	1,468
Foreman, John, Pottstown, Pa.		
Pittsburg, Cin., C. & St. L. Railway	1	
Bruce, Robert J., Logansport, Ind.		
Quebec & Lake St. John Railway	1	240
Doucet, A. E., Quebec, Canada.		
Southern Railway	14	6,741
Carpenter, James T., Princeton, Ind.		
Dodson, J. A., Greensboro, N. C.		
Evans, I. W., Birmingham, Ala.		
Fort, William A., Columbia, S. C.		
Hill, J. Y., Tuscumbia, Ala.		
Killebrew, O. D., Columbia, S. C.		
Lemond, J. S., Columbia, S. C.		
Lum, D. W., Washington, D. C.		
Marye, Burton, Richmond, Va.		
Morgan, J. W., Columbia, S. C.		
Rosseau, Julius H., Birmingham, Ala.		
Walton, C. R., Ashville, N. C.		
Welker, George W., Alexandria, Va.		
Woodard, W. R., Ashville, N. C.		
Southern Pacific Co.	6	5,924
Drake, R. M., San Francisco, Cal.		
Edinger, F. S., San Francisco, Cal.		
Isaacs, John D., San Francisco, Cal.		
Lloyd, Frederick F., Oakland Pier, Cal.		
Mallard, Charles C., Algiers, La.		
Robertson, Daniel, West Oakland, Cal.		
St. Louis Southwestern Railway	1	632
Berry, J. S., Tyler, Tex.		
St. L., B. & Mex. Railway	1	
Jonah, Frank G., Corpus Christi, Tex.		
San Antonio & Aransas Pass Railway	1	687
Berry, William, Yoakum, Tex.		
St. Joseph & Grand Island Railroad	1	312
Andrews, O. H., St. Joseph, Mo.		
St. Louis & San Francisco Railroad	1	2,923
Gooch, C. W., Cape Girardeau, Mo.		

Texas Midland Railroad	1	125
Green, E. H. R., Terrell, Tex.		
Toledo, Peoria & Western Railway	1	248
Markley, John H., Peoria, Ill.		
Toledo, St. Louis & K. C. Railroad	1	451
Shane, A., Frankfort, Ind.		
Texas & Pacific Railroad	1	1,712
Loughery, E., Marshall, Tex.		
Wabash Railroad	4	2,358
Cunningham, A. O., St. Louis, Mo.		
Danes, William S., Peru, Ind.		
Stannard, James, Moberly, Mo.		
Strain, T. M., Springfield, Ill.		
Wisconsin Central Lines	1	977
Tweedy, R. B., Milwaukee, Wis.		
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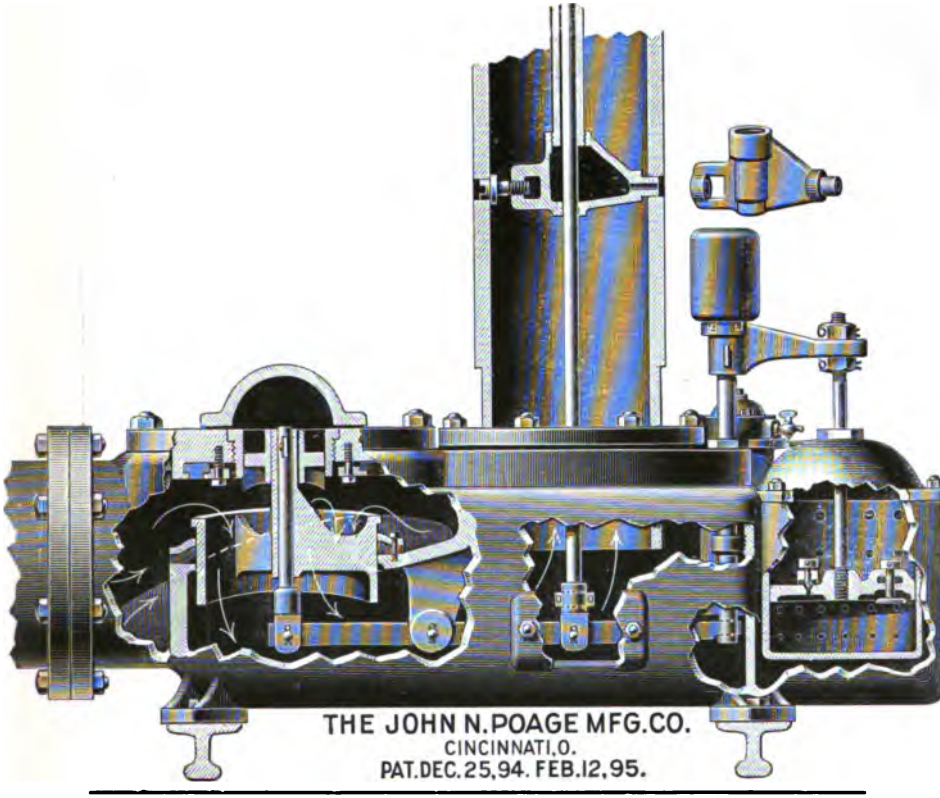

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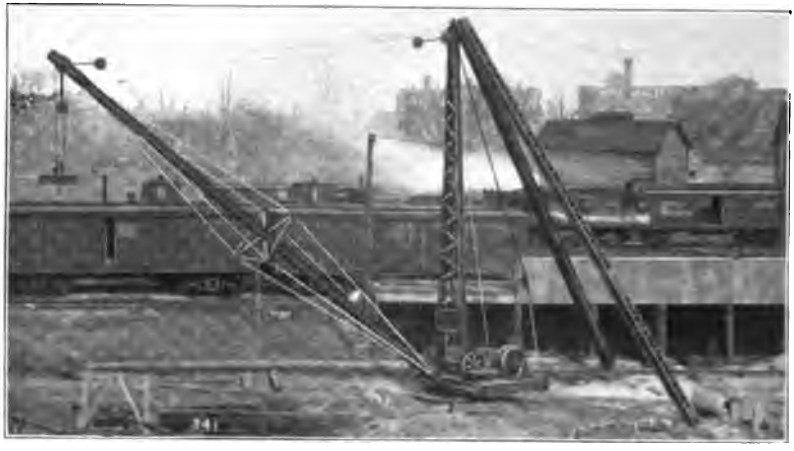

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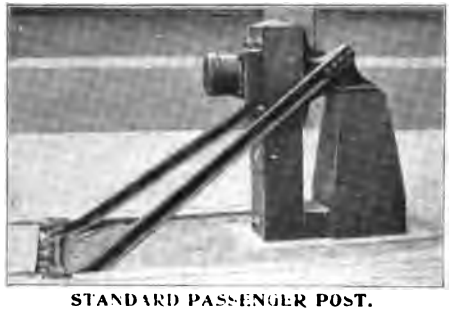

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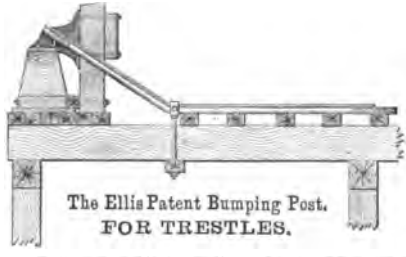

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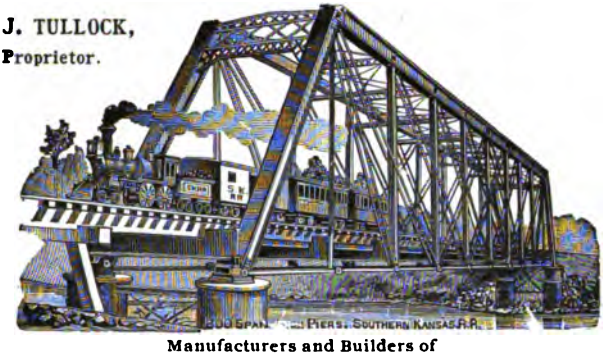

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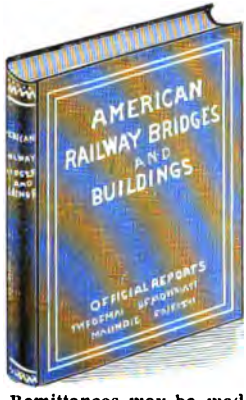

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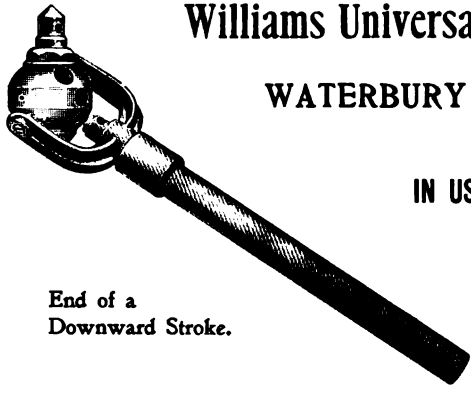

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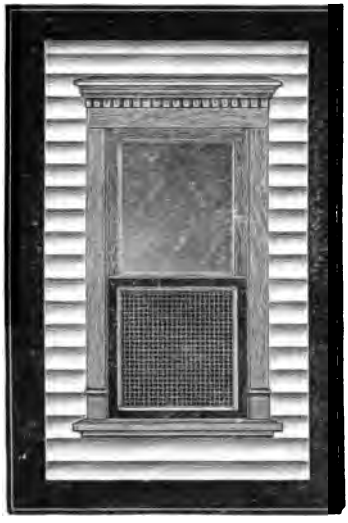

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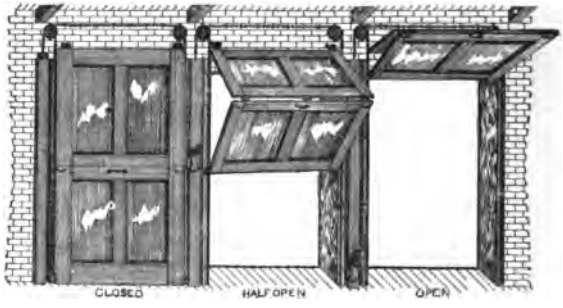

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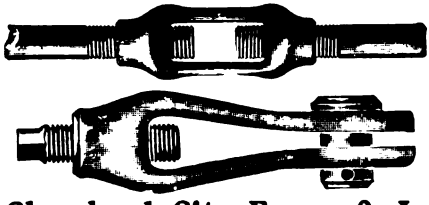

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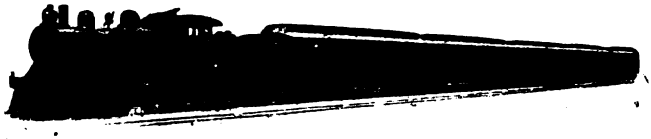

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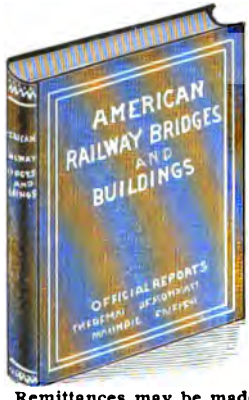

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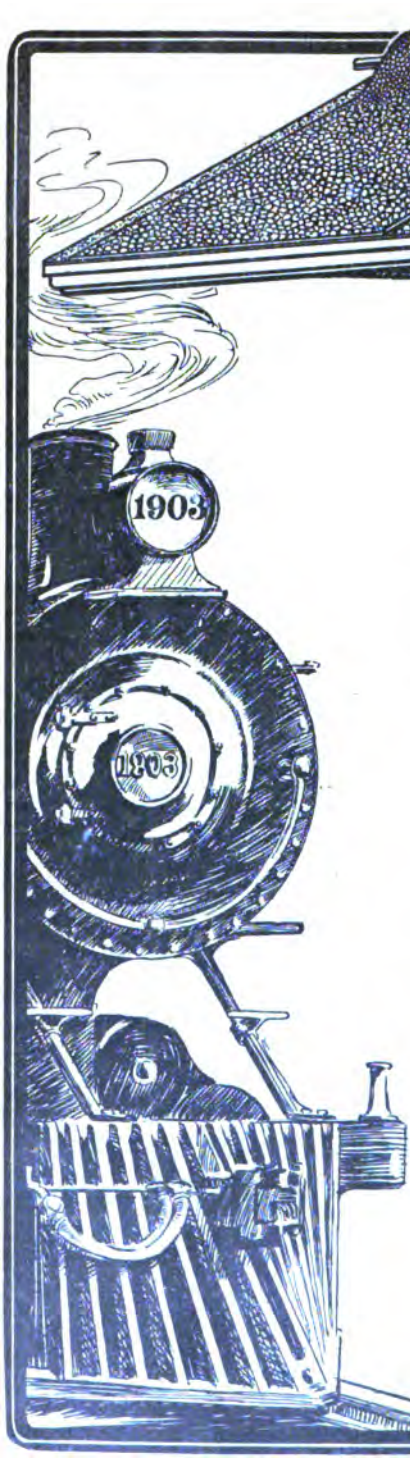

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